

7-1946

## Handbook on USSR Military Forces: Chapter XI -- Air Forces

War Department (USA)

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Technical Manual TM 30-430, Chapter XI  
30 July 1946

**Handbook on USSR Military Forces**  
**Chapter XI**  
**Air Forces**

**War Department**  
**Washington, DC**

Robert Bolin, Depositor, University of Nebraska-Lincoln Libraries

**Comments**

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**Abstract**

TM 30-340, Handbook on USSR Military Forces, was “published in installments to expedite dissemination to the field.” TM 30-430, Chapter XI, 30 July 1946, “Air Forces,” contains a detailed discussion of the organization, tactics, training, maintenance and supply, airfields, and weapons of the Soviet air forces. It contains numerous illustrations.

This chapter was originally classified as “Confidential” and later remarked “Restricted.” It was declassified in 1951.

This manual is listed in WorldCat under Accession Number: OCLC: 19989681

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**TM 30-430**  
**CHAPTER XI**

**TECHNICAL MANUAL**

**HANDBOOK ON U. S. S. R. MILITARY FORCES**

*TM 30-430 is being published in installments to expedite dissemination to the field. This chapter should be inserted in the loose-leaf binder furnished with Chapter V, November 1945*

**WAR DEPARTMENT**

WASHINGTON 25, D. C., 30 July 1946

TM 30-430, Handbook on U. S. S. R. Military Forces, is published for the information and guidance of all concerned.

[AG 300.7 (13 Mar 46)]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

EDWARD F. WITSELL

*Major General*

*The Adjutant General*

DWIGHT D. EISENHOWER

*Chief of Staff*

DISTRIBUTION:

AGF (80) ; ASF (2) ; T (10) ; Arm & Sv Bd (1) ; S Div ASF (1).

Refer to FM 21-6 for explanation of distribution formula.

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## CHAPTER XI

## AIR FORCES

## PART I. ORGANIZATION

## Section I. COMMAND ORGANIZATION

## 1. GENERAL

The air forces of the U. S. S. R. consist of separate forces, the most important of which are the Red Army Air Force and the Red Naval Air Force, integral parts of the Red Army and Navy. The Fighter Aviation of the Air Defense Forces of the Red Army, the Air Force of the NKVD, and the Civil Air Fleet are the remaining separate forces.

## 2. MAIN ADMINISTRATION OF THE RED ARMY AIR FORCE

**a. General.** The Main Administration of the Red Army Air Force, headed by commander of the Red Army Air Force, is the highest command and administrative organization of the Red Army Air Force. It is subordinate in technical and administrative matters to the Commissariat of the Armed Forces and, operationally, to the commander in chief and the General Headquarters.

Assisting the commander are a first deputy, a political deputy, various deputies and assistants, a Counterintelligence Division, a headquarters staff, and a military council.

**b. Military council.** The military council consists of the commander of the Red Army Air Force, the chief of staff, the chief of the Rear Services, the chief engineer, and the chief of the Political Administration. Its functions are the consideration of all policy matters pertaining to the Red Army Air Force and the appointment and dismissal of all senior air force personnel.

**c. Staff of the Red Army Air Force.** The staff of the Red Army Air Force, under the direction of the chief of staff, whose deputy is the chief of the operations section, acts as the operational center of the Main Administration of the Red Army Air Force. All sections of the staff of the Red Army Air Force work in close collaboration with and are limited in

function by the corresponding divisions of the Red Army General Staff. The staff is composed of seven sections as follows:

**OPERATIONS SECTION.** The Operations Section, which prepares detailed plans for employment of units on the basis of information supplied by other sections of the staff, works closely with the Operations Division in the Red Army General Staff.

**INTELLIGENCE SECTION.** The Intelligence Section supervises all intelligence organizations of subordinate air staffs. It is the center for collation and distribution of reports from subordinate staffs, but the publishing of such reports is the responsibility of the corresponding Intelligence Division of the Red Army General Staff. Assignment of reconnaissance missions, in accordance with the orders of the Red Army General Staff, also is a function of the Intelligence Section.

**ORGANIZATION SECTION.** The Organization Section is responsible for tables of organization and equipment, and for statistical control of strengths of all Red Army Air Force units.

**AIR TRANSPORT SECTION.** The Air Transport Section is responsible for the planning and coordination of all air transport operations, including, in time of war, those of the Civil Air Fleet.

**CIPHERS SECTION.** The Ciphers Section distributes and supervises ciphers and codes used in the Red Army Air Force. The Operations Division of the Red Army General Staff supplies the ciphers and determines time of change.

**METEOROLOGY SECTION.** The Meteorology Section controls all meteorological services of the Red Army Air Force and works in close coordination with the main administration of the Hydro-Meteorological Service of the Red Army.

**INTERNAL AFFAIRS SECTION.** The Internal Affairs Section supervises such matters as pay, rations, equipment, clothing, and billeting for personnel of the Red Army Air Force headquarters. It also su-

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pervises the Red Army Air Force buildings in Moscow and vicinity.

**d. The General Inspectorate.** The General Inspectorate supervises and advises the individual branches of the Red Army Air Force through the fighter, ground attack, bomber, *Sturman* (navigation, bombing, and observation), and technical inspectors.

There also is a General Department and, probably, a Chemical Warfare Department.

Some inspectors, such as the inspectors of flying technique, are attached to front-line units in headquarters of air armies, corps, and divisions. Others are sent on inspection trips of front-line units to serve as advisors and to carry out the functions of the General Inspectorate, i. e., to maintain high standards of flying and navigation and to investigate existing problems. Dismissals and appointments of personnel, even of high-ranking officers, may be effected by these inspectors.

**e. Main Administration of Airborne Forces.** Although the position of the air-borne forces in the organization of the armed forces of the U. S. S. R. is not clearly established, it is believed that they are controlled by a branch of the Main Administration of the Red Army Air Force. It is probable that the Main Administration of the Airborne Forces includes a military council, an operational staff, and the following administrations: Artillery, Engineer, Chemical Warfare, Signal Communications, Flight Service, Parachutes, Rear Services, Personnel (officer personnel), Combat Training (enlisted replacements), Political, and Counterintelligence.

**f. Main Administration of the Rear Services.** This office is one of the most important branches of the Main Administration of the Red Army Air Force. It is responsible for supply of air armies and, through them, for supply of the regional commands of aviation ground services and the air-field servicing battalions with items peculiar to the air arm. It also coordinates the requirements of operational air units for all other items of supply with the Chief of Rear Services of the Red Army. Its organization is analogous to that of the Main Administration of the Red Army Air Force, of which it is a part, with a political and other deputies, a headquarters staff, and subordinate administrations. The Main Administration of the Rear Services contains four staff sections and six administrations as follows:

**SECTION FOR REAR ORGANIZATION.** The Section for Rear Organization is in charge of organization for supply and of setting up new ground organization units.

**AIRCRAFT AND ENGINE ACCOUNTS SECTION.** This section is a central bookkeeping agency for aircraft and engines in the Red Army Air Force. It maintains current strength records extracted from the reports of senior engineers of units, schools, and repair shops.

**PERSONNEL SECTION.** The Personnel Section is responsible for officer personnel matters.

**INSPECTORATE.** The Inspectorate serves as an advisory and inspection administration for units of the rear services.

**ADMINISTRATION OF TECHNICAL SUPPLY.** The Administration of Technical Supply performs its functions of requisition of materials and supervision of storage through the following departments:

Technical Materials Department (glass, hardware, wood, etc., to be used for repair work).

Special Materials Department (fabrics, chemicals, metals, etc., for repair work).

Special Equipment Department (parachutes, cameras, etc.).

Spare Parts Department (spare parts for aircraft and engines).

Ammunition Department.

Stock Control Department (supervises utilization of surplus goods and repaired captured matériel).

Finance Department (settles accounts for supplies).

**ADMINISTRATION OF FUEL AND LUBRICANTS.** The Administration of Fuel and Lubricants receives requisitions for fuel and lubricants from Red Army Air Force units and insures distribution through a corresponding Fuel and Lubricants Administration of the Red Army. It operates through the following departments:

Central Depot Department (plans distribution of aircraft gas and lubricants and directs their storage on the basis of detailed accounts of gas and lubricant supplies).

Aircraft Gasoline and Lubricants Department (supervises distribution of aircraft gas and lubricants and directs shipments to air armies, replacement units, flying schools, and repair shops).

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Automotive Gasoline and Lubricants Department (forwards requisitions for automotive gas and lubricants from all units and installations of the Red Army Air Force to the Administration of Fuel and Lubricants, which then insures distribution).

Diesel Fuel Department (functions in the same manner as the above department, but deals with fuel for Diesel motors and anti-freeze products).

Requisition Department (compiles statistics from requisitions received from all Red Army Air Force installations and forwards them to the Administration of Fuel and Lubricants of the Red Army, and effects contracts with the State Oil Marketing Cooperative for aircraft gasoline and lubricants).

Finance Department (handles accounts with the State Oil Marketing Cooperative).

Transport Department (insures the allocation of rail and motor transport for gasoline and lubricants).

**ADMINISTRATION OF INTERNAL SUPPLY.** The Administration of Internal Supply controls issue and consumption of rations, clothing, and equipment through the Rations Department and the Clothing and Equipment Department. The Clothing and Equipment Department corresponds in function to the Main Intendance Administration of the Red Army.

**FINANCE ADMINISTRATION.** The Finance Administration, corresponding to the Main Finance Administration of the Red Army, is responsible for pay and for the budget for supplies and materials for the Red Army Air Force.

**ADMINISTRATION OF CAPTURED MATÉRIEL.** This administration, upon orders from the Captured Matériel Committee of the Red Army, supervises the allocation of captured aircraft equipment.

**ADMINISTRATION OF AIRFIELD SERVICING AND CONSTRUCTION.** This administration is divided into the following departments:

Airfield Servicing Department (services ground organization formations).

Airfield Construction Department (responsible for equipment and technical supplies for construction and development of airfields).

**g. Main Administration of the Engineer Service.** The Main Administration of the Engineer

Service is headed by the chief engineer of the Red Army Air Force, who also is a deputy of the commander of the Red Army Air Force and a member of the Military Council. His responsibilities include supervision of the activity of chief engineers of the air armies and air forces of the military districts. This main administration is responsible, in cooperation with the aircraft industry, for technical development of aircraft and equipment, aircraft repair methods, and airfield installations and equipment. The following administrations function under the Main Administration of the Engineer Service:

**ADMINISTRATION OF TECHNICAL SERVICE.** The Administration of Technical Service is the most vital part of the Main Administration of the Engineer Service. It controls, through the exercise of its inspectional function, the employment of aircraft, guns, and equipment and insures the serviceability of all aircraft stocks. Engineers of all air units and schools are under the supervision of the Administration of Technical Services. The administration also conducts close liaison with Red Army Air Force research institutes for improvement in aircraft design. It functions through five departments as follows:

- Imported Aircraft and Equipment Department.
- Fighter Aircraft Department.
- Ground Attack Aircraft Department
- Bomber Aircraft Department
- Schools Department.

**MAIN REQUISITION ADMINISTRATION.** The Main Requisition Administration places orders for aircraft and parts, guns, and equipment. It operates through 11 departments as follows:

- Special Materials Department.
- Technical Materials Department.
- Engines Department.
- Fighter Aircraft Department.
- Ground Attack Aircraft Department
- Bomber Aircraft Department.
- Spare Parts Department.
- Automotive Department.
- Electrical Armatures and Equipment Department.
- Heating Department.

**INVENTIONS ADMINISTRATION.** This administration corresponds to the Inventions Division of the Affairs Administration of the Commissariat of the Armed Forces. It studies inventions, and main-

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tains a construction bureau and experimental workshop for development work.

**ADMINISTRATION OF REPAIR SERVICE.** The Administration of Repair Service is divided into the following departments:

Field Repair Department.

Major Repairs Department.

Department for Installations, Repair Workshops, and Factories.

Department for Research and Introduction of New Repair Methods.

The Field Repair Department supervises all field repair shops and assigns them to air armies or military districts. The Major Repairs Department cooperates closely with the aircraft industry and the Main Administration of the Civil Air Fleet, whose repair shops effect the major repairs and overhauling of most Red Army Air Force aircraft. The department also exercises limited control over Red Army Air Force static repair shops. The Department for Installations, Repair Workshops, and Factories supplies machines and tools for repair work. The Department for Research and Introduction of New Repair Methods employs the Scientific Experimental Institute for Aircraft Repairs as a workshop to develop new repair methods.

**ADMINISTRATION FOR MECHANIZATION OF AIRFIELD INSTALLATIONS AND EQUIPMENT.** Responsibility of the Main Administration of the Engineer Service for airfield installations is discharged by this administration.

In addition to the above administrations, the Main Administration of the Engineer Service also maintains the following technical research institutes:

Scientific Research Institute of the Red Army Air Force. Research for development of new aircraft types and for improvement of existing types is conducted by this institute.

Scientific Research Institute for Aircraft Armament. This institute conducts research on aircraft armament and ammunition.

Scientific Research Institute for Aircraft Materials. This institute conducts research on materials employed in the manufacture of aircraft.

**h. Main Administration of Replacement and Training.** Although dealing with the same matters as the Main Administration for the Forma-

tion and Equipment of Units of the Red Army, this Main Administration of the Red Army Air Force differs in that its functions include training and replacement organization for officer personnel as well as for enlisted men. It is divided into two administrations as follows:

**ADMINISTRATION OF SCHOOLS.** The Administration of Schools controls all pregraduate air and ground crew training establishments of the Red Army Air Force. In this capacity it supervises training schedules and courses, and the procurement of instructors, equipment, and sites.

**ADMINISTRATION FOR ORGANIZATION OF UNIT FORMATION AND TRAINING.** The Administration for Organization of Unit Formation and Training is responsible for the operational training of air and ground crews sent from training establishments. It supervises replacements, reequipment, and activation of new units. Operationally subordinate to it are the replacement air brigades and the replacement air regiments.

**i. Administration of Air Academies.** The academies of the Red Army Air Force are supervised by the Administration of Air Academies, part of the Main Administration of the Red Army Air Force.

**j. *Sturman* Administration.** The *Sturman* Administration, whose chief is the assistant to the commander of the Red Army Air Force for *Sturman* (navigation, bombing, and observation) affairs, controls the *Sturman* service of all units and training institutions of the Red Army Air Force. The supervisory work of this administration includes improvement of navigation; operations and regrouping, insofar as *Sturman* regulations are affected; training of *Sturman* personnel in basic schools, replacement air regiments, and Air Force academies; operations of *Sturman* in air units; supply and improvement of navigational, bombing, and other *Sturman* equipment; and supply to the Red Army Air Force of visual beacon and radio equipment, maps obtained from Topographic Division of the Red Army General Staff, and literature on navigation, bombing, and other *Sturman* matters.

Subordinate to the chief of *Sturman* is the chief of the Aircraft Safety Service of the Red Army Air Force. He controls all aircraft safety personnel through the aircraft safety services in the air armies and air forces of military districts and through the

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reserve or special units of the Red Army Air Force Aircraft Safety Service. It is his duty to set up aircraft safety devices in rear and forward areas, to distribute information concerning aircraft safety devices and regulations, to inspect all aircraft safety stations, to supervise aircraft safety trainees, to maintain the distribution of aircraft safety devices, to coordinate types of equipment used by the Red Army Air Force with those used by various civil authorities, and to perfect new techniques for aircraft safety.

**k. Administration of the Aerial Gunnery Service.** The Administration of the Aerial Gunnery Service was created as a special administration in 1943. Its chief is the assistant to the commander of the Red Army Air Force in all matters pertaining to the Aerial Gunnery Service. The responsibility of this administration includes supervision of the training of flying personnel in the use of all aircraft armament in schools and front-line units as well as in replacement units, publication and supervision of regulations for the Aerial Gunnery Service, supervision of appointments of heads of the Aerial Gunnery Service within the Red Army Air Force, advising on aircraft armament for new aircraft, and initiating improved methods for effective use of aircraft armament.

**l. Administration of Signal Communications.** The Administration of Signal Communications formerly was part of the Ciphers Section of the Air Staff, under the general control of the Commissariat of Signal Communications. However, the introduction of radar and the increasing importance of radio communications resulted in the creation of signal units for the air forces warranting a separate administrative organization. The administration regulates tables of organization and equipment for signal units and supervises signal training programs, development of equipment, and new signal communications methods. It is subordinate technically and operationally to the Main Administration of Signal Troops of the Red Army and to the Signal Division of the General Staff. It maintains close liaison with scientific research institutes.

**m. Personnel Administration.** The Personnel Administration is responsible for appointments, promotions, decorations, and replacements of officer personnel in the Red Army Air Force. It maintains records of all officers, including those of the special services as well as flying personnel. It is probable

that this administration also controls officer replacements in conjunction with the Administration for Organization of Unit Formation and Training. It does not supervise officers schools.

**n. Administration of the Medical Service.** The Administration of the Medical Service, headed by the chief medical officer of the Red Army Air Force, cooperates closely with the main administration of the Medical Service, which is subordinate to the chief of the Rear Services of the Red Army. The administration of the Medical Service supervises the general health of air force personnel and conducts physical examinations. Although it maintains its own sanatoria, convalescent homes, and hospitals, air force personnel usually are hospitalized in Red Army hospitals.

### 3. LONG RANGE FORCE

Until the end of 1944, the Long Range Force was a separate air force, subordinate to the Peoples' Commissariat of Defense. Its operational employment against targets of special importance or in front-line sectors of special effort was determined by the General Headquarters. Units committed to a front-line sector may have been placed under temporary operational control of the air army of the sector.

The Main Administration of the Long Range Force was headed by a marshal of aviation. He was assisted by a general deputy, a political deputy, and staff sections and administrations similar to those of the Main Administration of the Red Army Air Force. It maintained its own servicing and training establishments.

Late in 1944, the Long Range Force was converted into an air army. It is probable that its command organization has been retained intact within the Main Administration of the Red Army Air Force.

### 4. AIR DEFENSE FORCES

The Main Administration of the Air Defense Forces is subordinate directly to the Commander in Chief, to the General Headquarters, and to the Commissariat of Defense, as are the other main administrations of the arms and services. It controls the fighter units allotted to it, the antiaircraft and early warning components of the strategic air defense system, and the passive civil defense system organized locally by the Commissariat of Internal Affairs. It is believed that since 1944 the fighter aviation of the Air Defense Forces has assumed a position of predominance over the antiaircraft artillery component within the Air Defense Forces.

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**5. RED NAVAL AIR FORCE**

During World War II, the Main Administration of the Red Naval Air Force was subordinate to the Commander in Chief of the Red Navy, to the Supreme Naval Council, and to the Commissariat of the Navy. However, since the reorganization of the Soviet armed forces in February 1946, the exact position of this branch is not clear.

The Main Administration of the Red Naval Air Force is believed to include staff sections and administrations similar to those of the Main Administration of the Red Army Air Force. The Red Naval Air Force has its own servicing and training organizations.

**6. CIVIL AIR FLEET**

The Civil Air Fleet is subordinate directly to the Council of Peoples' Commissars. During World War II, it was controlled operationally by the commanders of the Red Army Air Force and the Long Range Force.

The Main Administration of the Civil Air Fleet is known to include the following elements:

- Council (similar to the Military Councils).
- Director General.
  - Political Department.
  - Legal Department.
  - Medical Department.
  - Technical Department.
  - Construction Department.
  - Repair Department.
  - Personnel Department.
  - Publications Department.
- Inspectorate.

The main administration of the Civil Air Fleet also maintains a scientific research institute which is responsible for the following functions:

- Control of air routes, including planning and construction of new routes and fields;
- Supervision of registration of and permits for civil aircraft, flights outside the nation, and foreign air traffic;
- Direction of research for civil aviation and for new types of transport aircraft and equipment;
- Organization of fire-fighting and medical services;
- Organization of production of nonmilitary aircraft;

Supervision of repair and servicing of all Civil Air Fleet aircraft;

Supervision of training of Civil Air Fleet flying and ground personnel.

Operational control of the Civil Air Fleet by the Red Army Air Force and the Long Range Force during World War II included supervision of the following functions:

- Supply of Partisans and isolated ground force units;
- Movement of troops and wounded;
- Dropping of agents and paratroopers;
- Courier, transport, ferrying, and photographic missions.

It extended even to the promotion and decoration of Civil Air Fleet personnel employed in military operations. However, elements of the Civil Air Fleet employed in military operations remained under the administrative control of the Main Administration of the Civil Air Fleet.

The lower echelons of the Civil Air Fleet are divided into district commands, each of which is similar to the Main Administration of the Civil Air Fleet. The district commands are authorized to negotiate with the Soviet Republics and to supervise officers in command of units and airfields within the districts. Some Civil Air Fleet districts coincide with military districts of the Red Army. Civil Air Fleet branch offices are located in all other military districts where there is no Civil Air Fleet Administration.

**7. AIR FORCE OF THE NKVD**

The Administration of the Air Force of the Commissariat of Internal Affairs (NKVD) controls the air units of the NKVD. (For further details, see ch. IV.)

**Section II. TACTICAL AIR FORCES****1. AIR ARMIES OF THE RED ARMY AIR FORCE**

**a. General.** Air armies, which include both flying and servicing organizations, are the largest operational units of the Red Army Air Force. They are responsible for the conduct of aerial warfare for an Army group (front). The flying formations and service units are directed by the commander of the air army, his staff, and a military council (fig. 1).

The flying units of an air army include a variable number of air corps, independent air divisions, and a few independent regiments and squadrons. Usually included among the independent regiments and

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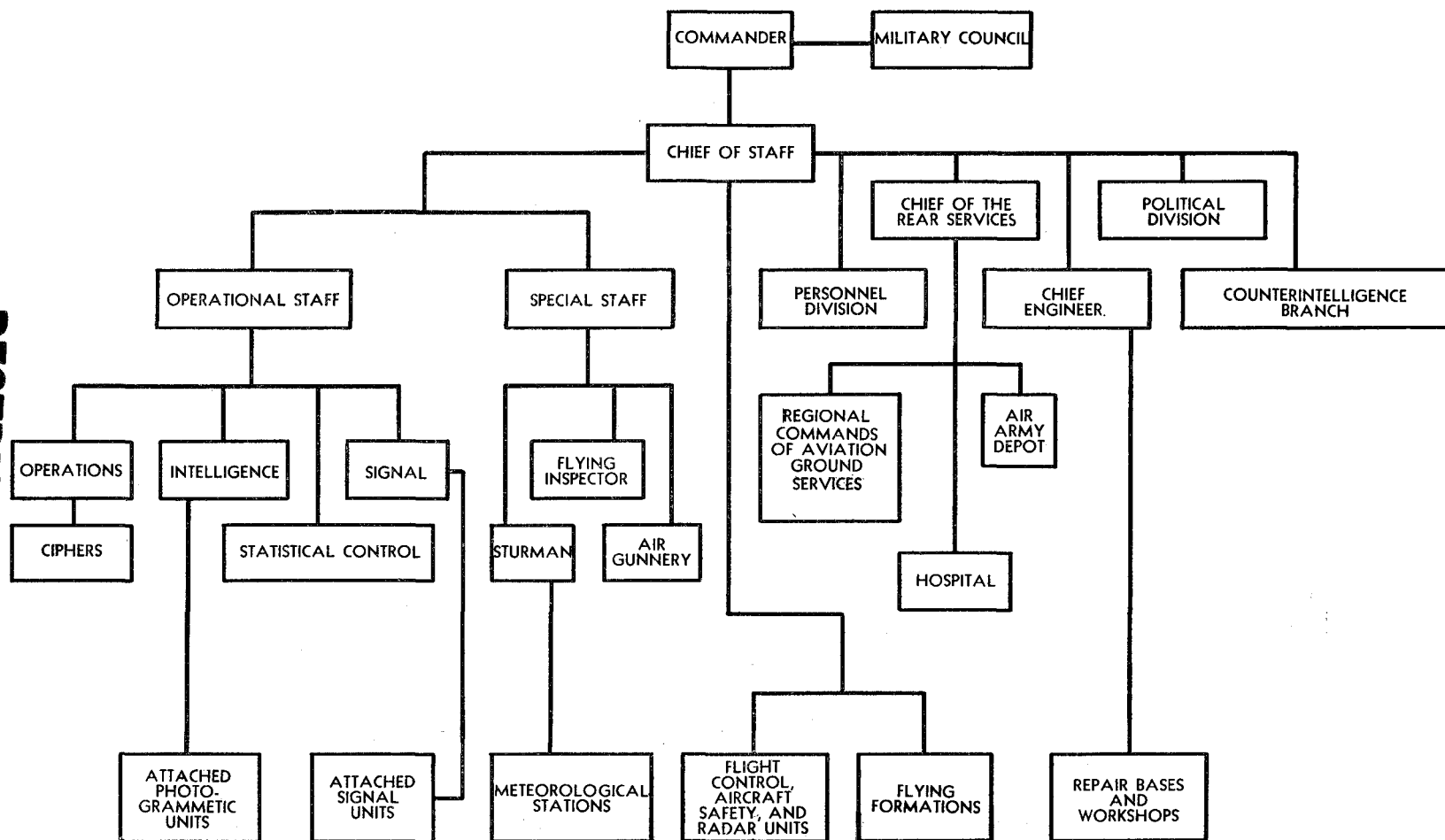


Figure 1.—Organization of an air army.

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squadrons attached directly to an air army are reconnaissance regiments (both long and short range), several reconnaissance spotting regiments, and a liaison regiment or squadron from the Civil Air Fleet. During the early part of World War II, a demonstration and training regiment usually was attached to each air army, but these are believed to have been disbanded.

Most of the service units within the ground organization of the air army are grouped under regional commands of aviation ground services, which are subordinate to the chief of the rear services of the air army. Regional commands of aviation ground services are administrative organizations operating as headquarters of ground regions. The number of regions into which an air army is divided may vary. At the end of World War II, there was an average of five per air army. Subordinate to a regional command of aviation ground services are the following ground units:

Several airfield servicing battalions, each servicing one or, in exceptional cases, two to three air regiments.

An airfield engineer battalion.

Several airfield technical companies, one attached to each airfield servicing battalion.

One captured matériel company.

One to two independent motor transport battalions.

Several truck workshops for minor repairs, attached to the airfield servicing battalions.

Several independent signal companies, one attached to each regional command of aviation ground services and airfield servicing battalion.

One advanced supply depot.

Several airfield weather stations, attached to airfield servicing battalions.

Service units directly subordinate to members of

Components	Number per air army	Personnel per unit	Aircraft per unit	Trucks per unit	Total personnel	Total aircraft	Total trucks
Air army headquarters	1	500	(10)		500	(10)	
Fighter corps	1	1, 655	258		1, 655	258	
Ground attack corps	1	3, 283	387		3, 283	387	
Bomber corps	1	2, 278	198		2, 278	198	
Independent fighter division	1	790	129		790	129	
Independent ground attack division	1	1, 060	129		1, 060	129	
Long-range reconnaissance regiment	1	387	35		387	35	
Short-range reconnaissance regiment	1	387	(35)		387	(35)	
Reconnaissance spotting regiment	5	(300)	(35)		(1, 500)	(175)	
Liaison regiment	1	(300)	(35)		(300)	(35)	
Liaison squadron	1	33	10		33	10	
Regional command of aviation ground service	5	93	3		465	15	
Airfield servicing battalion	30	270		70	8, 100		2, 100
Airfield engineer battalion	5	500		70	2, 500		350
Airfield technical company	30	120		7	3, 600		210
Independent truck battalion	5	200		80	1, 000		400
Truck workshop (for minor repairs)	30	40		4	1, 200		120
Signal regiment	1	1, 136			1, 136		
Signal battalion	3	(400)			(1, 200)		
Signal company	39	150			5, 850		
Independent signal company	35	56		8	1, 960		280
Air force weather station	30	8		2	240		60
Divisional weather station	9	7			63		
Advanced supply depot	1	150			150		
Air army depot	1	(100)			(100)		
PARM-1	36	12		2	432		72
PARM-2-5		(30)		5			
Static aircraft repair shop	1	(250)			(250)		
Railway aircraft repair workshops	1	(250)			(250)		
Static truck repair workshop	1	(250)			(250)		
Aircraft safety station							
Flight control unit							
Radar unit	1	60			60		
Total					40, 977	1, 416	3, 592

NOTE.—Figures in parentheses are tentative.

Figure 2.—Estimated strength of an average air army.

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the air army staff include: an air army depot, subordinate to the Chief of the Rear Services; several mobile aircraft repair bases (usually, one for each air division), their mobile aircraft repair shops as well as independent mobile aircraft repair shops, a static aircraft repair shop, a railway aircraft repair shop, all subordinate to the chief engineer; a possible static truck repair shop, the subordination of which is not known; an air signal regiment, subordinate to the Chief of the Signal Service; other signal units, attached to flying formations; aircraft safety stations, which probably are subordinate to the chief *Sturman*, but which also are subordinate to the Chief of the Signal Service for services involving the use of Red Army Air Force signal equipment; flight control and radar units, subordinate to the chief *Sturman*; and a photogrammetric company, subordinate to the Chief of the Intelligence Service.

The average air army is estimated to include 41,000 officers and enlisted men, 1,400 aircraft, and from 3,500 to 4,000 trucks (fig. 2). The large number of trucks is an indication of the high degree of mobility of the components of an air army.

**b. Air corps.** Air corps originally were formed in the latter part of 1942 as staffs controlling a number of divisions to facilitate the redeployment of units and the commitment of new units. The corps then became subordinate to the commander of the air army to which it was assigned temporarily. Whenever a mobile ground force formation was supported by an entire air corps, liaison personnel usually were assigned to the staff of the air corps.

By 1943 air corps were operating on a more permanent basis, and the corps staffs were assuming many of the operational and administrative functions of air army staffs. At the end of World War II, many corps had been subordinate to the same air armies for a sufficient length of time to warrant the assumption that they should no longer be considered a mobile reserve.

The staff of the air corps, although larger, is similar to that of an air division (fig. 3). It maintains operational and planning control over its subordinate divisions in a manner similar to that of an air army staff. Two, or occasionally three, air divisions normally are subordinate to an air corps. They all are of the same type, i. e., fighter, bomber, or ground attack. One fighter division occasionally is included in a ground attack corps to provide fighter protection. During World War II, there also were

some mixed air corps, but these were replaced gradually by homogeneous corps.

**c. Air divisions.** Air divisions, tactically subordinate to air armies or corps, initiate no independent decisions regarding operations, but operate only on orders from the staffs of the air armies or corps. The division commander determines which of the subordinate regiments shall be employed, and may even select the crews in critical situations.

Staff	Type of division	
	Fighter and ground attack	Bomber
Headquarters.....	3	3
Political division.....	6	6
Operations staff.....	19	24
Special staff.....	14	24
Engineer division.....	5	10
Rear services.....	2	4
Liaison flight.....	9	9
<b>Total .....</b>	<b>58</b>	<b>80</b>

Figure 3.—Personnel strengths for air division staffs.

Divisions and corps are designated, according to function, as fighter, bomber, or ground attack. Divisions usually contain three regiments of the same role, although four or more regiments occasionally have been identified with a division. By the end of World War II, most divisions were equipped with aircraft not only of the same role, but also of the same type. Ground attack divisions occasionally contained one fighter regiment, but by the end of the war most ground attack divisions also were completely homogeneous. As in the case of air corps, mixed divisions seem to have been discarded.

**d. Air regiments.** Air regiments are subordinate to air divisions, or are "independent" regiments directly subordinate to an air army or to the Red Army Air Force.

Regiments subordinate to an air division are assigned to operations by the division, usually for a period extending only for 24 hours. The commander of the regiment arranges the order of take-off, method of approach, and other operational details. Commanders of independent regiments assume more responsibility for planning and carrying out orders.

Air regiments are the fundamental Red Army Air Force units, having fixed tables of organization and equipment. At the beginning of World War II, all

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tactical regiments had 60 aircraft, but they were reduced to 20 planes per regiment after the tremendous losses of the first few weeks. By February 1943 the strength was increased to 32 aircraft. Present personnel and aircraft strengths for the principal types of air regiments of the Red Army Air Force are shown in figure 4. For break-down of personnel strengths of regiments and squadrons see figure 6.

Strength	Type of regiment		
	Fighter	Ground attack	Bomber
Number of squadrons.....	3	3	3
Combat planes.....	36	36	27
Liaison and training planes.....	2	2	2
Headquarters planes.....	4	4	3
Personnel.....	244	337	342 <sup>1</sup>

<sup>1</sup> Varies slightly with type of bomber employed.

Figure 4.—Present personnel and aircraft strengths of Red Air Force regiments.

Independent regiments vary more in strength than regiments subordinate to divisions. Both long and short range reconnaissance regiments, usually subordinate to the Reconnaissance Section of the air army, have variable numbers of squadrons. Reconnaissance spotting regiments, operationally subordinate to army group artillery commanders, have 32 aircraft including 2 squadrons of 10 fighter aircraft, 1 squadron of 10 ground attack aircraft, and 2 liaison planes. Another special type of regiment, which, although not employed during most of World War II, may become more prominent in the future, is the weather reconnaissance regiment. In August

1944 the existence of an air reconnaissance regiment, subordinate to the Hydro-Meteorological Service and especially trained to make weather observation flights, was reported. It employed 20 light bomber aircraft.

**e. Air squadrons.** Air squadrons almost invariably function as elements of the regiment to which they are subordinate, rather than as independent units. During World War II, the trend was to eliminate independent squadrons attached to the headquarters of air corps or air divisions by incorporating them into independent regiments. By the end of the war, only communication and medical squadrons (elements of the Civil Air Fleet) remained independent in the Red Army Air Force, although a few independent liaison squadrons still may be attached directly to army group and army staffs.

Squadrons are divided into flights, usually three, of from three to four planes each, depending upon the role of the squadron. Aircraft and personnel strengths of various types of squadrons are shown in figure 5.

**f. Regional commands of aviation ground services.** The regional commands of aviation ground services, which are headquarters organiza-

Type squadron	Aircraft	Personnel
Fighter.....	3 flights of 4 planes.....	65
Ground attack.....	do.....	93
Bomber.....	3 flights of 3 planes.....	97
Reconnaissance.....	do.....	98
Liaison.....	do.....	33

Figure 5.—Aircraft and personnel strengths of squadrons.

	Fighter		Ground attack		Bomber		Reconnaissance		Liaison
	Regiment	Squadron	Regiment	Squadron	Regiment	Squadron	Regiment	Squadron	Squadron
Headquarters.....	3	4	3	4	3	4	3	4	2
Political division.....	4	.....	4	.....	4	.....	4	.....	1
Operations staff.....	12	.....	12	.....	15	1	49	2	3
Special staff.....	7	1	7	1	7	1	15	1	4
Engineer division.....	7	9	7	10	8	18	8	18	2
Headquarters flight.....	13	39	22	54	11	46	11	46	10
Liaison.....	3	.....	3	.....	3	.....	3	.....	.....
Total headquarters staff personnel.....	49	53	58	69	51	70	93	71	22
Flying personnel.....	.....	12	.....	24	.....	27	.....	27	11
Total squadron personnel.....	.....	65	.....	93	.....	97	.....	98	33
Total regimental personnel (on basis of headquarters staffs and 3 squadrons).....	244	.....	337	.....	342	.....	387	.....	.....

Figure 6.—Personnel strengths of air regiments and squadrons.

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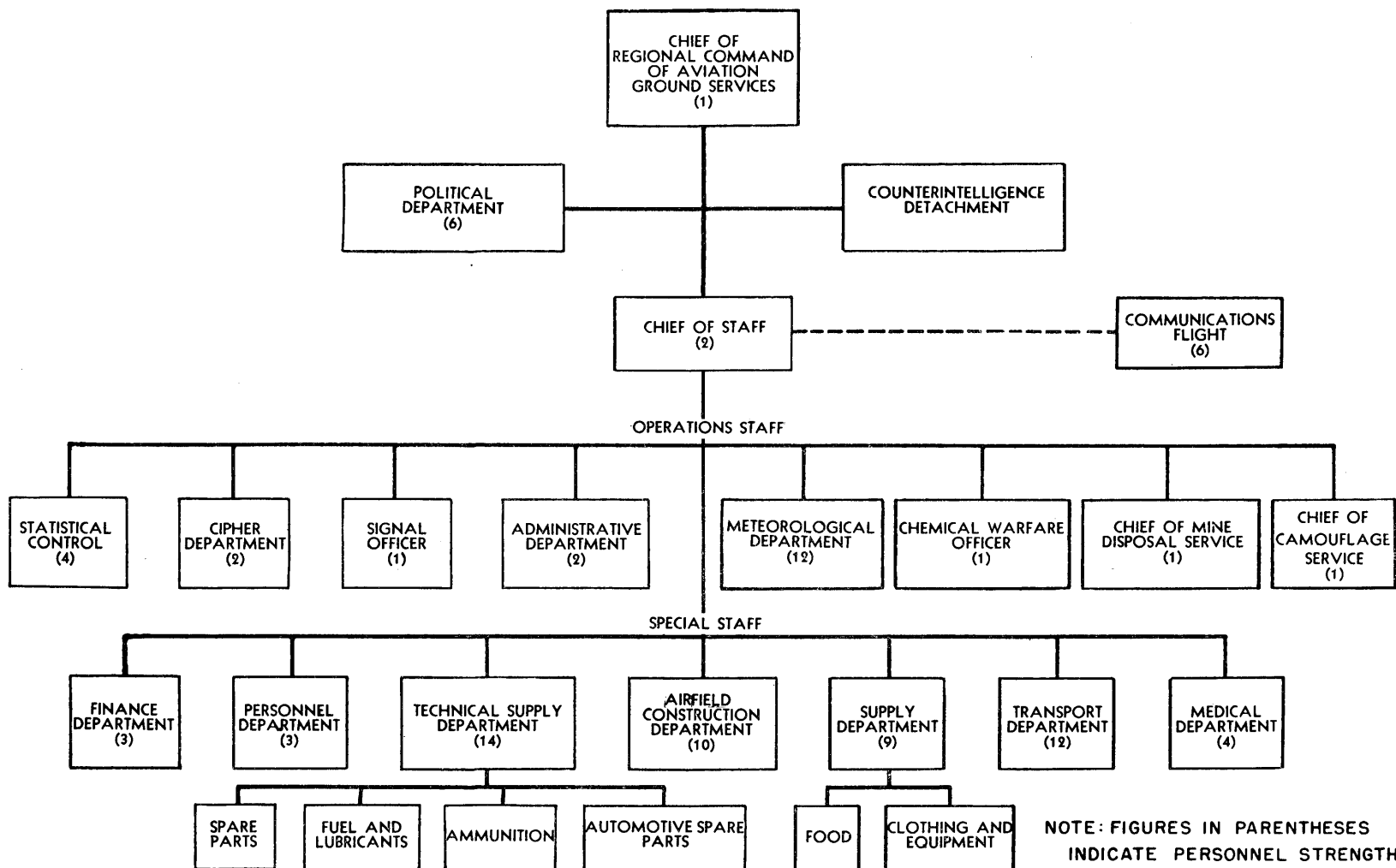


Figure 7.—Organization of regional command of aviation ground services.

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tions for the main servicing units, are subordinate immediately to the Chiefs of the Rear Services of air armies or of air forces of military districts. They are subordinate only operationally to the air corps or divisions deployed within their regions, which may issue necessary orders for the proper functioning of their units. Functions of regional commands of aviation ground services include organization of unit movements, allocation of supplies, and control of operations of subordinate units according to instructions from the air armies. Staff organization of regional commands of aviation ground services is shown in figure 7.

**AIRFIELD SERVICING BATTALION.** The Airfield Servicing Battalion is subordinate operationally to the commander of the air regiment or regiments which it services, but otherwise to the regional command of aviation ground services. It includes a staff, an airfield company, a truck company, and a technical supply department, which is divided into sections for spare parts and engines, fuel and lubricants, and ammunition. Each airfield servicing battalion has approximately 270 personnel and 70 trucks. Each battalion normally services one air regiment, but in some cases may service two to three. If more than three regiments are serviced by a battalion, a subordinate headquarters is established at a subsidiary airfield.

The Airfield Servicing battalion normally is stationary. When a flying unit moves out of the area, it must be serviced by another battalion.

Services provided include upkeep of airfields (other than repair or large-scale work), guarding of airfields and installations, construction of take-off and landing equipment, transportation of fuel and ammunition to unit technical personnel, provision of transport for unit movements, removal of damaged aircraft, maintenance of weather service, and provision of rations, quarters, and medical service for unit personnel.

**AIRFIELD ENGINEER BATTALION.** There is at least one Airfield Engineer Battalion subordinate to the Airfield Construction Department of each regional Command of Aviation Ground Services. In addition, there are reserve battalions at the disposal of air armies. Each battalion includes three companies, a pioneer and truck squad, and one field truck repair shop. Personnel strength varies between 350 to 500, plus civilian recruits for manual labor. Approximately 70 vehicles, including tractors, are divided

among the companies. Tractors, fuel cars, and ambulances are assigned to the truck squad.

Building and repair of airfields is the responsibility of the airfield engineer battalion. Sites for new airfields are selected by detachments from the battalion and the airfield servicing battalion, under the direction of the regional command of aviation ground services.

**AIRFIELD TECHNICAL COMPANY.** The Airfield Technical Company is subordinate to the Airfield Servicing Battalion for operations, but is subject to the commander of the Regional Command of Aviation Ground Services for discipline and to the Airfield Construction Department of the regional command for technical matters.

Each company consists of three platoons. It has approximately 120 personnel and from 6 to 7 trucks. It is the responsibility of the airfield technical company to carry out maintenance of airfield installations and to complete new airfields laid out by the airfield engineer battalion.

**INDEPENDENT MOTOR TRANSPORT BATTALION.** Subordinate to each Regional Command of Aviation Ground Services is an independent motor transport battalion consisting of two transport truck companies and one special truck company of two platoons and a truck repair shop. Although each battalion originally was equipped with 250 vehicles, it is believed that the number has been reduced to 80, of which 20 are tank cars and 60 are trucks. It is believed that each battalion includes approximately 200 personnel.

Since routine transporting of supplies is one of the functions of the airfield servicing battalion, the independent motor transport battalion may be considered as a reserve for special tasks, such as large-scale movements and transfers.

**INDEPENDENT CAPTURED MATÉRIEL COMPANY.** Subordinate to each Regional Command of Aviation Ground Services is an independent captured matériel company, consisting of two platoons and a demolition unit. It is believed to include approximately 130 men and from 14 to 18 trucks.

**INDEPENDENT SIGNAL COMPANY.** An Independent Signal Company, consisting of a radio and a telephone platoon with a personnel strength of approximately 56 men and equipped with 8 trucks, usually is attached to each Regional Command of Aviation Ground Services and Airfield Servicing Battalion.

**ADVANCED SUPPLY DEPOT.** Supply units included in the ground organization of the Red Army Air

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Force are under the ultimate authority of the main administration of the Rear Services. They include central supply depots in the rear areas, air army depots, and advanced supply depots.

The advanced supply depot is subordinate to the regional command of aviation ground services and consists of a clerical and accounting staff and sections responsible for different types of supplies. Personnel strength is approximately 150 men. The main function of the advanced supply depot is to provide the regional command with supplies for air units.

**g. Specialized control units.** The aircraft safety stations are subordinate to the Aircraft Safety Service, which is under the control of the *Sturman* Administration. They are controlled, in respect to services involving the use of Red Army Air Force signal equipment, by the chief signal officer of the air army.

**h. Repair units.** The following types of repair units, under the ultimate authority of the Main Administration of the Engineer Service, are employed in the ground organization of the Red Army Air Force: mobile aircraft repair shops, static aircraft repair shops, railway aircraft repair shops, mobile truck repair shops, and static truck repair shops.

There are five types of mobile aircraft repair shops (PARM's), ranging from PARM-1 to PARM-5, the figure indicating the number of repair trucks. PARM-1's are subordinate in disciplinary and technical matters to mobile aircraft repair bases, which serve as their administrative headquarters. One mobile aircraft repair base, controlling from three to five PARM-1's, usually is attached to each air division, although it is subordinate directly to the field repairs section under the chief engineer of the air army. Operationally, the PARM-1 is subordinate to the chief engineer of the air regiment to which it is attached. It depends upon the regional command of aviation ground services and its subordinate units for supplies, rations, and billeting.

A PARM-1 normally includes approximately 12 men, a repair truck, and 1 to 2 transport vehicles. Its chief function is the performance of minor repairs the air regiment technicians are unable to handle. PARM's-2 to -5 are subordinate to the section for major repairs under the chief engineers of air armies, and are employed on major repairs either in rear areas or as mobile reserves for front-line repair work.

Static aircraft repair shops also are subordinate to the section for major repairs under the chief engineers of air armies. There usually is one static aircraft repair shop, with a strength of several hundred men, for each air army. They repair aircraft which are too badly damaged to be repaired by PARM's, and assemble so-called "new" aircraft from parts of damaged planes or captured aircraft.

Railway aircraft repair shops are subordinated the same as the static aircraft repair shops. They include several hundred men and approximately 30 railway cars, outfitted as repair shops.

Mobile truck repair shops are believed to be attached to the airfield servicing battalions, and to be subordinate ultimately to the regional command of aviation ground services. There are believed to be two types of these repair shops. Type A repair shops handle simple truck repair work and have approximately 10 men per truck. Usually, from two to three trucks are attached to units which employ trucks. Type B repair shops are attached to transport units, and may include as many as 50 men.

There are very few static truck repair shops. They are designed for major repair of truck equipment and are believed to have a strength of several hundred men.

**i. Air signal service.** Senior signal officers commanding signal units are subordinate to the Administration of Signal Communications in the Main Administration of the Red Army Air Force. They receive orders to establish signal communications from the chief of staff or the operations department of the air unit to which the signal unit is attached. Operational signal units are divided into two main types. The so-called regular units function as organic parts of the air units. The independent signal units, although at the disposal of air units, have a more flexible organization (fig. 8).

The largest operational units of the Air Signal Service are air signal regiments, which serve air armies. Air signal battalions serve air corps, and air signal companies serve air divisions, regiments, regional command of aviation ground services, and airfield servicing battalions.

Personnel strength of an air signal regiment is approximately 1,136. Air signal companies vary between 100 to 200 men, depending on the type of air unit serviced. The air signal units maintain signal communications with subordinate staffs, with aircraft in flight, between air and ground units, and

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with the other air forces, such as the fighter aviation of the Air Defense Forces (PVO). In order to fulfill these tasks, the air signal units maintain the following establishments:

- Signal traffic centers.
- Telephone and telegraph links.
- Radio nets and two-station links.

Signal traffic centers, consisting of a teletype station, a radio receiving and transmitting center, a message center, and a central telephone exchange are located near the staff command post of each air unit.

Telephone and telegraph contact with staffs of higher and lower formations, ground units, cooperating air units, the Aircraft Reporting Service of the Air Defense Forces, and with radio transmitting centers and nearby message centers of the Commissariat of Signal Communication (NKS) are maintained by the air signal units. Both the Red Army Air Force and the Red Army use the NKS network.

Radio is the most important means of communication. Radio contact is established by the air signal units with staffs of higher and lower formations, ground units, cooperating air units, planes in flight,

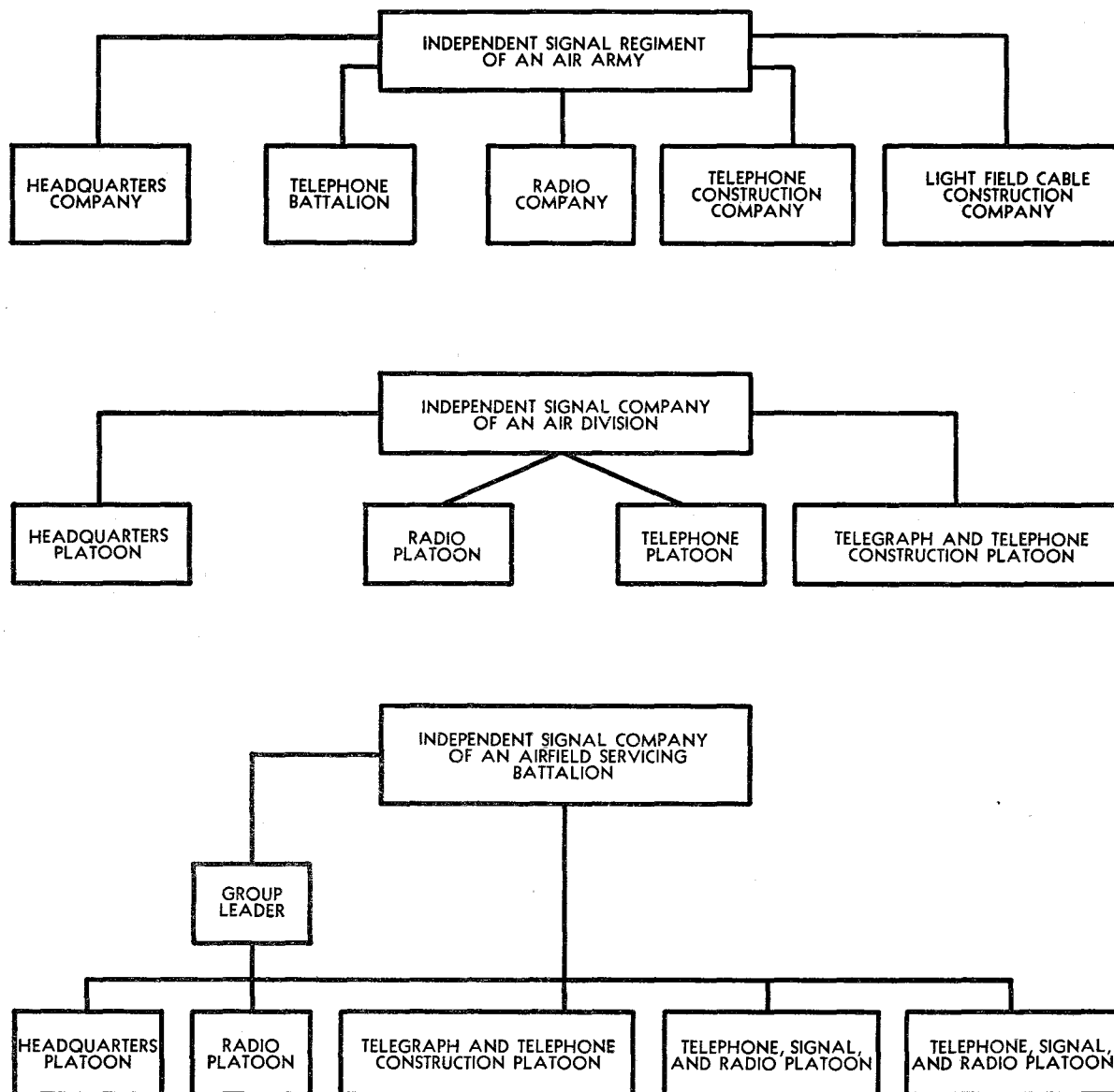


Figure 8.—Organization of independent air signal regiments and companies.

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and for reception from air defense units. Air signal units also establish radio stations for the aircraft control and warning systems of the Air Observer Corps, for the command posts of air units, for service at points of concentration and those requiring fighter protection, and for all airfields.

**j. Meteorological service.** The chief of the weather service of an air army is subordinate to the chief *Sturman* of the air army. The weather service within the region of the air army consists of airfield weather stations, which provide weather information to air regiments, and of weather stations attached to operational staffs of air corps and divisions.

The airfield weather stations are subordinate to the commanders of Airfield Servicing Battalions for discipline, to the chiefs of the Meteorological Service of the Regional Commands of Aviation Ground Services for technical matters, and to the *Sturman* of the air regiments for operations. An airfield weather station normally includes eight men: the chief of the station, a senior meteorologist, two junior meteorologists, two wireless operators, and two observers. This group moves with its airfield servicing battalion and is equipped with two trucks. Divisional weather stations are believed to include seven men: chief of the station, an engineering meteorologist, a senior meteorologist, a junior meteorologist, two wireless operators, and one observer.

It is the task of each aviation weather station to provide weather information for flights within its own region to the *Sturman* of the air unit. If the air formation flies beyond the boundary of the region, its weather station must arrange for the information to be supplied by the weather stations through whose regions it passes. The reports of the aviation weather stations are based entirely on the forecasts of the Central Forecasting Institute at Moscow, and information only up to 6 hours in advance may be issued.

## 2. RED NAVAL AIR FORCE UNITS

**a. Flying units of the naval air arm.** Flying units of the naval air arm attached to the four fleets (Black Sea, Baltic Sea, Arctic, and Pacific) and a few units attached to the flotillas of the Red Navy consist of air divisions (formerly called brigades), with component regiments and squadrons. A few independent reconnaissance regiments and squadrons may have direct subordination to fleet command staffs. There are no naval air corps.

Naval air force divisions are designated according

to role, as are those of the Red Army Air Force. They, also, contain from three to four regiments. In addition to the types of units found in the Red Army Air Force is the mining and torpedo division, which also may include bomber regiments. Personnel and aircraft establishments of naval air force regiments correspond closely to those of the Red Army Air Force.

Naval air force units are employed for attacks on ports, ships, harbor installations, and on enemy shipping. They also are used in reconnaissance activity, in support of amphibious operations, and in support of ground forces engaged in coastal areas.

**b. Servicing units.** The largest unit in the ground organization of the Red Naval Air Force is the naval air base. It includes departments for administering supply, equipment, spare parts, pay, rations and billeting, transfers, guarding of airfields, and minor repairs. The largest bases have a personnel strength of 650, and usually service an entire naval air division, administering as many as four airfields. Smaller bases, 400 men, service from one to two regiments and not more than two airfields.

All bases are assigned to a naval air division and are subordinate to the division commander. Subsidiary airfields and seaplane units are serviced by special detachments. Several small repair shops and a larger repair shop, which is not an integral part of the base but which is subordinate to the base commander, are assigned to each base. Subsidiary airfields and seaplane units are serviced by special detachments.

## Section III. STRATEGIC AIR FORCES

### 1. LONG RANGE FORCE

**a. Flying units.** As originally constituted, the Long Range Force was organized into divisions and regiments. But by 1943 these were incorporated into corps. In December 1944 the Long Range Force was converted into the Eighteenth Air Army, but the division of component units into corps of two divisions each, three regiments per division, remained the same.

A long range bomber regiment consists of three squadrons, with a total of 381 officers and enlisted men. Personnel strength varies somewhat according to the type of aircraft employed. Division staff and regimental personnel strengths are shown in Figures 9 and 10.

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Headquarters.....	3
Political division.....	6
Operations staff.....	33
Special staff.....	27
Engineer division.....	7
Rear services.....	12
Liaison flight.....	13
<b>Total.....</b>	<b>101</b>

Figure 9.—Strength of long range bomber division staff.

	Staff	Squadron (each)
Headquarters.....	3	4
Political division.....	4	
Operations staff.....	17	1
Special staff.....	8	1
Engineer division.....	9	20
Headquarters flight.....	13	46
Liaison flight.....	3	
<b>Staff total.....</b>	<b>57</b>	<b>72</b>
<b>Flying Personnel.....</b>		<b>36</b>
<b>Total squadron personnel.....</b>		<b>108</b>
<b>Total regimental personnel (staff and three squadrons).....</b>	<b>381</b>	

Figure 10.—Strength of long range bomber regiments.

**b. Servicing Units.** The ground organization of the Long Range Force was, before its incorporation into the Red Army Air Force, completely independent. As in the fighter aviation of the Air Defense Forces, there were no regional commands of aviation ground services. But each air regiment had its own airfield servicing battalion which moved with the regiment. Airfield servicing battalions were subordinate to the division commander for discipline and to the divisional supply deputy for technical matters. Each battalion averaged approximately 250 officers and enlisted men and from 40 to 50 vehicles.

Just before the incorporation of the Long Range Force into the Red Army Air Force, it was reported that signal, antigas, and meteorological units were separated from the airfield servicing battalions and given independent status. All radio communications were controlled by the Long Range Force staff in Moscow, and each regiment maintained its own meteorological station.

For repair work, PARM's, from 10 to 12 men, were subordinated to each regiment. Supply was effected through special Long Range Force depots which were given the same designation (GAS) as those of the Red Army Air Force.

After the incorporation of the Long Range Force into the Red Army Air Force, it is probable that the Red Army Air Force servicing system was applied to Long Range units.

## 2. AIRBORNE FORCES OF THE RED ARMY AIR FORCE

**a. Flying Units.** Although the airborne forces have a small air force, it now consists only of training planes. They have no operational flying units. Units and aircraft for World War II operations were supplied by the Red Army Air Force (particularly by the Long Range Force) and by the Civil Air Fleet.

**b. Tactical units.** The basic tactical formation is the airborne brigade, with four airborne battalion landing teams each. Airborne corps served as operational headquarters for three or more brigades prior to 1943. Their existence after the reorganization at that time has not been confirmed. Guards airborne divisions have no connection with the airborne forces, but are rifle divisions made up in part of former airborne personnel.

The first battalion landing team of the airborne brigade is wholly parachuted, while the other teams are mixed.

Principal components of the airborne brigade are as follows:

Brigade headquarters (approximately 170 officers and enlisted men).

Signal company.

Chemical defense platoon.

Medical platoon.

Mobile reconnaissance company (approximately 120 officers and enlisted men).

Pioneer company (approximately 80 officers and enlisted men).

Rifle battalions (four) (approximately 690 officers and enlisted men each).

Headquarters.

Signal platoon.

Reconnaissance platoon.

Pioneer platoon.

Rifle companies (three per battalion) (three 50-mm mortars each).

Mortar company (six 82-mm mortars).

Machine gun company (twelve 7.62-mm heavy machine guns).

Antitank rifle company (twenty-seven 14.5-mm antitank rifles).

Medical platoon.

Supply platoon.

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Artillery battalion (approximately 230 officers and enlisted men).

Howitzer batteries (two) (four 76-mm infantry howitzers each).

Mortar battery (four 120-mm mortars).

Antitank battalion (approximately 220 officers and enlisted men).

Antitank gun batteries (four) (four 45-mm antitank guns each).

Antitank rifle company (eighteen 14.5-mm antitank rifles).

Antiaircraft battalion (approximately 170 officers and enlisted men).

Gun platoon (four 37-mm automatic anti-aircraft guns).

Antiaircraft machine gun companies (two) (twelve 12.7-mm antiaircraft machine guns each).

Brigade services.

Each brigade totals approximately 3,750 to 3,850 officers and enlisted men.

Weapons in the airborne brigade are as follows:

76-mm infantry howitzers.....	8
45-mm antitank guns.....	16
37-mm antiaircraft guns.....	4
120-mm mortars.....	4
82-mm mortars.....	24
50-mm mortars.....	36
12.7-mm antiaircraft machine guns.....	24
7.62-mm heavy machine guns.....	48
14.5-mm antitank rifles.....	126
7.62-mm light machine guns, rifles, and submachine guns.....	not known

In general, the airborne brigade is comparable in organization, strength, and armament to the rifle regiment, although it is somewhat larger and has greater fire power in all categories, especially anti-aircraft weapons. There are a number of distinctive characteristics. These include the greater emphasis on light mortars, the concentration of all battalion heavy machine guns in one strong machine gun company and similar concentrations of antitank guns in the brigade antitank battalion and the difference in organization and proportion of howitzers and heavy mortars.

A few organizational trends have been established. Since 1942 increasing emphasis has been placed on antitank artillery and on antiaircraft weapons. Mortars have increased in caliber. In 1942 the 37-mm. mortar was the basic mortar for air-borne troops. It is believed that armored reconnaissance recently has been added to the airborne brigade.

## Section IV. AIR FORCES OF THE ZONE OF THE INTERIOR

### 1. FIGHTER AVIATION OF THE AIR DEFENSE FORCES

**a. Flying Units.** The fighter aviation of the Air Defense Forces (PVO) consists of air corps, divisions, and regiments equipped with fighter aircraft. The tables of organization and equipment are similar to those of the air armies, although there probably is considerable variance depending upon the area of operations.

Air Defense Forces fighter corps were to be found, during World War II, in every part of the U. S. S. R. where concentrated fighter defense was necessary. Operationally, they were subordinate to the military district in which they were located. Corps near front line areas may have been subordinate operationally to air armies. After extension of the front line beyond the Soviet frontier, the fighter aviation of the Air Defense Forces defending areas close behind the front was divided into three sectors. Cooperation with the air armies at the front probably was maintained by Air Defense Forces fighter liaison officers.

**b. Servicing units.** The Air Defense Forces fighter force employs airfield servicing battalions but no regional commands of aviation ground services.

### 2. TRAINING AND REPLACEMENT UNITS

**a. Flying units.** Replacement units are organized into replacement brigades, regiments, and squadrons. Replacement brigades are subordinate to the Administration for Unit Formation and Training of the Main Administration of the Red Army Air Force. Each brigade probably deals with replacement and training for aircraft of a particular role, although they are not designated specifically as fighter, bomber, or ground attack. It is believed that there are from two to four regiments in each brigade. The replacement regiments usually contain from three to four squadrons, although there were more subordinate squadrons early in World War II. Each replacement air regiment includes from 140 to 180 officers and enlisted men and from 50 to 80 aircraft, depending upon the function of the regiment. The squadrons are divided into three flights, each training from 6 to 10 fighter or ground attack pilots or from 3 to 5 bomber crews.

The functions of replacement units include opera-

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tional training of service school graduates as front line replacements, training of air-crew personnel for new types of aircraft, and ferrying of aircraft from factories either to operational units or to special storage depots near the front. Early in World War II, most of the replacement units were located near large aircraft factories. But by the middle of 1944, they began to move closer to the front.

From 1941 to 1942, the shortage of aircraft made it impossible for the replacement units to retrain and refit depleted units effectively. That function became the responsibility of newly created demonstration and training units, one of which usually was located at the rear of each air army. However, with the increase of aircraft production, the demonstration and training units gradually were disbanded.

**b. Servicing units.** Servicing of training establishments and replacement units is the responsibility of material-technical supplies battalions, similar to airfield servicing battalions, which are subordinate directly to the commander of the training school or the replacement regiment. Repair shops and radio stations are integral parts of the material-technical supplies battalions, but in other respects, their organization probably differs very little from that of the airfield servicing battalions.

### 3. CIVIL AIR FLEET UNITS

**a. Flying units.** During World War II, the Civil Air Fleet adopted a military organization of air divisions, regiments, and squadrons. The composition of divisions is believed to have been very flexible. The regiments are believed to have contained from 4 to 6 squadrons of from 18 to 20 aircraft each. Special liaison regiments were employed directly by Red Army staffs.

**b. Servicing units.** Civil Air Fleet units in the rear areas or those flying regular air routes use the ground services of the airfields from which they operate. When Civil Air Fleet units are employed in military work, they are assigned airfield servicing battalions and mobile aircraft repair shops. However, the units, even when tactically subordinate to the Red Army Air Force, continue to employ the independent Civil Air Fleet meteorological service.

### 4. NKVD AIR FORCE UNITS

The air force of the Peoples' Commissariat of Internal Affairs (NKVD) is organized into a brigade of three regiments, each having approximately two squadrons and five independent squadrons. In addition, there are a few other air regiments and squadrons. Each regiment probably has no more than 10 to 15 aircraft.

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## PART II. TACTICAL EMPLOYMENT

### Section I. POLICY OF EMPLOYMENT

#### 1. GENERAL

The geographical position and territorial expanse of the U. S. S. R. are factors from which has sprung a traditional and firmly established conviction that the sure defense of the U. S. S. R. lies with the Red Army. The years following World War I, although witnessing many new developments, did not produce anything which seriously shook this belief. The course of World War II tended to strengthen this conviction, with the result that the Red Army Air Force has developed into an arm which is, in the highest degree, specialized for the protection and support of the Red Army.

#### 2. RED NAVAL AIR FORCE

The U. S. S. R., despite access to the Arctic and Pacific Oceans, always has been purely a land power. In comparison with the Red Army Air Force, the Red Naval Air Force is indeed small.

Before the outbreak of World War II, the Soviets attempted to equip the Red Naval Air Force with ship-borne aircraft and seaplanes. At the outset of the war, a considerable number of obsolete hydroplanes did exist. They were used by the fleet air arms chiefly for aerial reconnaissance. Ship-borne aircraft, on the other hand, were available only in very small numbers and were used as catapult aircraft on warships and icebreakers for reconnaissance.

Lack of aircraft carriers and the increasing demands of the Red Army Air Force during World War II caused the Soviets to discontinue production of naval aircraft. Consequently, with the exception of the obsolete models which existed before the war and the small number of PBY's received on lend-lease, the bulk of the Red Naval Air Force is land-based and is equipped with the same types of aircraft as the Red Army Air Force.

**a. Missions of the naval air force.** During the last year of World War II, the Red Naval Air Force engaged in attacks on enemy supply ports, disorganization of sea supply routes by attacks on enemy convoys and individual ships, convoy escort, defense of naval bases, reconnaissance for itself and for the fleets, support of ground forces during en-

agements in coastal areas, and support of amphibious operations.

Some variations between the operations of the naval air arms of the various fleets have been noted.

**BLACK SEA FLEET.** The air arm of the Black Sea Fleet was engaged actively in attacks on sea targets during the mopping-up operations against German troops cut off in the Crimea. Previously, German convoy routes had been out of range of the Soviet air bases. After the fall of Sevastopol, the air arm played an active part in the defense of harbors in the area, particularly where units of the Red Navy were stationed. It also played an active part in supporting and protecting landings at Novorossisk and at Kerch. Reconnaissance flights over the coastal area were flown for both the fleet and for the army. Attacks were made on coastal fortifications and, to a lesser extent, on harbor installations. In a few cases, the air arm supported ground forces.

**BALTIC SEA FLEET.** At the beginning of World War II, the air arm of the Baltic fleet operated primarily in defense of strongpoints of the Baltic fleets, such as at Kronstadt. It also supported ground operations for the defense of Leningrad and, when the Red Army went over to the offensive, supported the drives up the Karelian Isthmus and toward Narva. Considerable reconnaissance activity was carried out over coastal areas and targets at sea. During the latter part of the war, the Baltic air arm was engaged actively in harassing the German withdrawal.

**ARCTIC FLEET.** The air arm of the Arctic Fleet was employed at the beginning of World War II in defense of Murmansk and Archangel. Later, it was used for defense of convoys, blockading of German fighter bases, and for attacks on German convoys and harbors in northern Norway. It also participated in attacks on German coastal batteries in addition to usual reconnaissance duties.

**PACIFIC FLEET.** It is believed that the functions and tasks of this air arm were essentially the same as for those air arms in the west.

**b. Differences between Red Naval and Army Air Forces.** There is a superficial similarity in the composition and organization of the Red Naval and Army Air Forces in that each employs the same air-

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craft establishments in the regiment, 42 aircraft in fighter and ground attack regiments, 32 aircraft in bomber regiments; in the grouping of regiments into divisions; in the grouping of divisions in fleet air arms; and in parallel composition of ground organization.

However, in addition to the omission of the corps from the Red Naval Air Force chain of command, there are a number of other essential differences.

In the Red Naval Air Force, operational specialization by regiments has been developed to a high degree. In some cases, there are even specialist divisions, such as mining and torpedo divisions. Regimental specialization is prescribed by the high command of Red Naval Air Force, whereas the high command of the Red Army Air Force has avoided specialization.

The different specialization policies affect the basing of air units. The Red Army Air Force seeks dispersion, while in the Red Naval Air Force an entire division usually is based on one airfield.

Naval bomber, ground attack, and fighter personnel are trained in essentially the same manner as those for the Red Army Air Force, with a relatively small amount of special naval training covering cooperation with naval units and conditions governing flights over the sea. Training of mining and torpedo crews is more extensive.

**c. Conclusion.** Several factors have a direct bearing on the strategic employment of the Red Naval Air Force and give rise to conditions affecting its future. First, it is to be noted that the aircraft types with which the Red Naval Air Force is equipped are the same as those used by the Red Army Air Force, with minor adaptations for specialized work. Secondly, the forces of the various air arms are interchangeable and can be moved from one fleet to another as strategic considerations dictate. Thirdly, the employment of the naval air arms to support ground forces in the performance of operations which normally would have been undertaken by the Air Army, was reported frequently during World War II.

### 3. LONG RANGE FORCE

The Long Range Force, alternatively described as the Long Range Bomber Force, is not designed as, nor has the capacities of a strategic bomber force, as understood by western nations. While independent in status and under independent command, it seldom

operated against objectives beyond the short-term strategic demands of a specific ground offensive.

Strategic bombing was carried out against German towns from June to September 1941. Strategic bombing then was discontinued until the following July, when raids were continued until November, virtually marking the end of strategic bombing for World War II. In these attempts at strategic bombing, the performance of the Long Range Force was unimpressive in plan and execution.

From May 1942 until the end of 1944, intermittent strategic raids were carried out against German occupied towns.

In December 1944, the title of the Long Range Force was changed to Air Army. The implications of this change of title are not known precisely, but they are certain to extend beyond the mere change of name. For some time, the interests of the personnel of the Long Range Force had become increasingly detached from those of the air armies of the Red Army Air Force. Hostility consequently had arisen between the two air forces. It was detrimental to morale, and the Red Army Air Force obstructed Long Range Force administration, supply, and even, occasionally, operations. The change of title, it is believed, was designed primarily to overcome these difficulties, and may well have been only one part of a general adjustment of administrative machinery to produce closer cooperation between the two forces.

The great majority of Long Range Force operations were in direct and indirect support of a succession of ground offensives. As World War II progressed, its role became even more restricted. During the offensives of 1944 and 1945, its targets almost invariably were the railway facilities and rolling stock from 50 to 190 miles behind the enemy's defensive line.

Indications of the value placed by the Soviet high command on the Long Range Force presents much conflicting evidence. The growth of the Long Range Force during World War II indicates a considerable interest in its progress and confidence in its ultimate operational effectiveness. Personnel manning the force were selected carefully, and there were expectations of its emergence as an elite corps. There appears, however, evidence that the ostensible interest taken in the force exceeded the degree of priority given its demands on industry. The Long Range Force was badly equipped from the start. Also, its operational performance has been discreditable.

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The Long Range Force was neglected over long periods in favor of the air armies. Its prominent position in Soviet propaganda probably was associated with Soviet appreciation of a world-wide knowledge of the power of the bomber forces of the Western Allies.

The Soviets well realize their shortcomings in strategic long-range bombing. The nucleus for the formation of such a force exists in the Long Range Force. However, much remains in the development of aircraft, equipment, and of operating doctrines before a thoroughly modern strategic force can be realized by the U. S. S. R.

#### 4. FIGHTER AVIATION OF THE AIR DEFENSE FORCES

Fighter aviation of the Air Defense Forces is not believed to constitute a single integral force comparable to the Long Range Force or the Civil Air Fleet. It is comprised, in contrast, simply of Red Army Air Force units temporarily or permanently allotted to the Main Administration of the Air Defense Forces, to the commanders of air defense fronts, or to the air defense fronts, or to the air defense commanders of military districts.

It is under the operational control of the air defense commander of each defensive sector in the rear of the combat zone, and, is employed in conjunction with anti-aircraft artillery, searchlights, barrage balloons, radar, visual and sound observation, and the passive defense forces of the NKVD. Over-all administrative and planning responsibilities for these allotted fighter units appears to be centralized in a low-ranking fighter force commander and staff in the headquarters of the Main Administration of the Air Defense Forces.

#### 5. CIVIL AIR FLEET

The term "Civil Air Fleet," may refer generally to all nonmilitary aircraft, by whomever held, or in a restricted sense to those specifically controlled by the Main Administration of the Civil Air Fleet. Actually, no private persons or agencies hold title to aircraft in the U. S. S. R. Within the limitations imposed by public authority, however, nongovernmental users may direct the employment of aircraft. In addition to the Civil Air Fleet, the following agencies may operate nonmilitary aircraft:

The Main Administration of the Northern Sea Route.

Government departments, such as the various commissariats.

Public organizations, such as *Osoaviakhim*.

Private persons.

All of these, except the Main Administration of the Northern Sea Route, come under the policy-making authority of the Civil Air Fleet. All are subject to its inspections. The centralization of policymaking and inspection in the Civil Air Fleet indicates the existence of a coordinated plan of control not only for aircraft within the fleet itself but for all non-military aircraft.

In peacetime, the Civil Air Fleet maintains passenger, mail, and cargo operations, and renders special services, such as aerial photography, sowing of seed, and spraying. During World War II, it furnished many units for operational use by the Red Army Air Force and provided air transport in the rear areas for both civil and military personnel.

**a. Control by Red Army Air Force.** Both before and during World War II, the Civil Air Fleet was subordinate directly to the Council of Peoples' Commissars. During the war, however, the fleet also was subject to a degree of control by the Red Army Air Force, and some fleet units were subordinated to it. The operations staff of the Civil Air Fleet, however, was responsible directly to the Council of Peoples' Commissars. Consequently, the exact limits of civil and military control are difficult to determine. However, it seems certain that the Red Army Air Force had plenary power over the military employment of the Civil Air Fleet. The Long Range Force had the authority to request flying personnel from the Civil Air Fleet and to make its own selections. The extent of Red Army Air Force influence in the civilian employment of the Civil Air Fleet is uncertain. It seems probable that the Red Army Air Force had paper authority to assign Civil Air Fleet equipment according to requirements and to control its activity, but that in practice only partial use was made of this authority and that the Civil Air Fleet retained freedom in matters not strictly military.

Elements of the Civil Air Fleet engaged in military operations continued to be designated as fleet units and were administered by the Main Administration of the Civil Air Fleet, even though they operated under Red Army Air Force directives. Civil Air Fleet divisions belonged to the rear areas and never appeared intact in the area of the front, although units as large as squadrons and regiments were so em-

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ployed. Units operating at the front were at the disposal of army group or air army headquarters and were serviced by the air army ground organization. Subordination was limited to operations, however, and did not affect their status as Civil Air Fleet units. Except for units attached to the Main Administration of the Medical Service, the Civil Air Fleet had no specialized military assignments.

**b. Missions.** No hard and fast distinction can be drawn between the military and civil operations of the Civil Air Fleet. Even during World War II, air routes were operated in the rear areas with at least an outward preservation of their civilian character. Throughout the war, moreover, the Civil Air Fleet retained a fairly large stock of aircraft, some as organized transport units and some merely scattered over the civil airfields of the rear areas.

During World War II, the missions assigned to the Civil Air Fleet were divided into three general categories: those in the theater of operations, those in the zone of the interior, and those outside of the U. S. S. R.

In the theater of operations, the Civil Air Fleet transported supplies for ground forces (particularly isolated units), transported wounded personnel, transported combat troops, dropped paratroopers and agents, supplied partisans, and, in exceptional cases, flew night raids.

In the zone of the interior, the Civil Air Fleet maintained courier and transport service and, in emergencies, was used for the transfer of nonflying personnel of flight regiments. In addition the Civil Air Fleet performed special work for the Commissariats of Agriculture and Forestry.

Outside of the Soviet Union, the Civil Air Fleet maintained the U. S. S. R.'s foreign transport services and ferried imported foreign aircraft.

In peacetime, the scope of Civil Air Fleet activities is considerably narrower. It embraces air transport and courier services, flights connected with agriculture, forestry, and other branches of Soviet economy, scientific research in civil aviation, geodesy and aerial photography, medical service, and operations for cultural, educational, and recreational purposes.

**c. Types of aircraft.** The principal units of the Civil Air Fleet are equipped with the C-47 or its Soviet counterpart, the PS-84 (one version called the LI-2 when equipped with armament). In addition, captured German Ju-52's and some older Soviet bombers, such as the four-engine TB-3, also are

utilized. For training and courier service, the U-2 and R-5 (both similar to the U. S. Stearman PT-17) are used extensively. It has been noted recently that the Soviets are using a number of the more modern DB-3F (IL-4) twin-engine bombers for transport work, and it seems likely that the proportion of modern types will increase as the Civil Air Fleet continues to expand.

**d. Operations.** According to Soviet statements, the Civil Air Fleet flew 40,000 operational flights totaling more than 4,500,000 miles, and carried more than 2,300,000 passengers and 300,000 tons of cargo during World War II. These figures allegedly do not include nonmilitary air activity under control of the Main Administration of the Civil Air Fleet.

In civil operations, again according to Soviet statements, from 1923 to 1937, flights covered 142,500,000 miles and carried 1,000,000 passengers and 110,600 tons of freight. By 1938, the combined length of Civil Air Fleet routes was 57,700 miles. While civil operations were restricted during the early part of World War II, it is known that by 1944 the Civil Air Fleet was flying not only a large network of air routes within the Soviet Union, but was extending into foreign countries.

At present, a consistent policy is being pursued of maintaining traffic connections beyond the frontiers with Civil Air Fleet aircraft and crews, rather than permitting foreign airlines to enter Soviet territory.

**e. Conclusions.** The Soviets appreciate the importance of air transport, as evidenced in the early and continuous attention given to the Civil Air Fleet, to its training program, and to the development of internal and external air routes. During World War II, it served as an important adjunct to the Red Army Air Force, and it is logical to assume that it will be expanded. In an Aviation Day address on 18 August 1945, Marshal Astakhov (Commander of the Civil Air Fleet) stated that Soviet economic development requires 8 to 10 times the volume of civil air transport as was carried prior to the war. This statement appears to be a significant indication of the importance attached to the future development of the Civil Air Fleet.

## 6. AIRBORNE FORCES

At the beginning of World War II, the U. S. S. R. was as well or better equipped with trained airborne troops as was any other nation. In contrast to other forces of the U. S. S. R., the airborne forces decreased in size during the war. Varying types of

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airborne operations were carried out in 1941, 1942, and 1943. It is possible that airborne operations also were attempted during the latter 2 years of the war, but they have not been reported.

Soviet airborne tactical doctrine embraces all the missions commonly accepted for parachute, glider, and transport-landed troops. Both large- and small-scale operations have been attempted. In large-scale operations during World War II, it is of interest to note that airborne troops generally were employed against critical enemy salients only when the denial of areas of supply or communications at the base of the salient would seriously cripple the enemy and losses to airborne forces would not be too severe. Landings generally were made in an area, in the rear of the enemy's salient, which would affect most seriously the coordination of the enemy's supply lines and, at the same time, avoid the enemy's front-line troops and make possible a break-through to friendly ground forces within a reasonable period. A landing area in the rear of the enemy salient and close to one of its flanks usually was selected. Airborne operations seldom succeeded in any more than the denial mission. The process of breaking out was accomplished only at a great cost in men, equipment, and time.

Small-scale operations during World War II consisted of cooperating with fast moving mobile forces on penetration or encirclement missions and of independent missions in the enemy's rear to raid headquarters, sabotage installations, and to reinforce active Partisan groups.

## **Section II. DOCTRINE OF EMPLOYMENT OF THE AIR ARMY**

### **1. GENERAL**

The employment of air armies, which constitute the tactical and operational forces of the Red Army Air Force, clearly exemplifies the role of aviation in support of the Red Army. Normally, each air army is assigned to an army group and operates under the orders of the army group commander. The employment of the air army is, therefore, governed primarily by the plans of the ground forces.

### **2. AIR-GROUND COORDINATION**

**a. Responsibility.** Air-ground coordination is achieved by the Soviets through specific allocations of responsibilities to air and ground commanders participating in an operation.

**DURING OFFENSIVE.** In planning an offensive, responsibilities for successful air-ground coordination are prescribed as follows:

*The army group commander* must, in his over-all plan, stipulate the missions, types, and degree of air support required for the individual phases of the operation. In addition, it is his responsibility to specify the order in which the missions are to be executed by the air army in the event of breakthrough into the enemy defensive zone, the areas and sectors which must be covered by aerial reconnaissance, and the amount and type of support to be provided by the air army and ground units operating outside the zone of main effort. He also prescribes the assistance ground forces will render the air army in terrain reconnaissance, construction of airfields, and ground defense of air installations.

*The army group staff* works out the details of the field order, giving particular attention to the table of combat coordination (fig. 17, ch. V) for the projected operation. (In many instances, a detailed field order is prepared for only the first day of the ground offensive. Thereafter, fragmentary orders are more common.)

In conjunction with the tables of combat coordination, they determine lanes, front-line crossing points, bomb lines, and radio and supplementary signals for air-ground communications and target designation. The army group staff places particular stress upon effective air cover for artillery and mobile troops during all phases of combat. Stress similarly is placed upon effective support of air forces by counterbattery fire against enemy anti-aircraft artillery and by ground-air-warning units. In addition, the staff also must prepare a detailed plan of the army group's aerial reconnaissance requirements.

Within the army group staff, the Chief of Staff personally is responsible for the establishment of air-ground signal communications. This specifically includes the determination of the axes of signal communication for all major ground and air components and the locations of their respective signal centers at various phases of the operation. In addition, he must issue instructions regarding the allocation of major stations, composition of key nets, and the tentative missions of signal reserves. The signal plan and detailed signal operating instructions are prepared by the army group signal officer.

*The air army commander*, in accordance with the over-all army group plan, is responsible for the spe-

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cific assignment of air formations and units, including those to be retained under centralized control and those to be attached to mobile units during various phases of the operation. In addition, he assigns operational airfields to these units and issues general instructions relating to the preparation of navigation, ground control, and target designation signal networks.

*The commander of the infantry army* in the main effort and all other infantry army commanders to whom aircraft are attached, or who are to be supported directly by air units, must verify all aircraft lanes, front-line crossing points, and bomb lines by personal ground reconnaissance. They also must insure the full coordination of signal communications and space-time schedules.

*The army artillery commanders*, in conjunction with the commanders of supporting or attached air formations, are charged specifically with the detailed integration of artillery and air support fire plans. In addition, they must prepare a mutual support plan against enemy antiaircraft artillery and enemy aircraft. (For typical plan of air-artillery coordination, see fig. 17, ch. V.) They determine the exact distribution of targets as to space and time, manner in which targets are to be indicated or fire discontinued, and arrange for the exchange of information during the artillery and aviation preparations.

In all cases, the artillery must know the time, place, and altitude at which the friendly aviation will cross the front line and the signals for designating targets and for shifting or ceasing fire. When artillery and aviation are to attack the same target it is necessary to establish beforehand the order of attack, and both must operate upon a single plan. The altitude at which aircraft are to fly must be prescribed definitely in order to avoid the trajectories of artillery projectiles.

*The commander of mobile troops* (tanks, mechanized troops, and cavalry) must determine, in conjunction with the commanders of the air formations or units who will be attached or will support them, the specific plan of air cover and fire support for the mobile troops. They also must establish the detailed plan of maneuver, the space-time schedules, and the system of air-ground communications and liaison for the entire operation. A final responsibility of the mobile commander is to assist in terrain reconnaissance and construction of landing strips in areas captured during the operation.

**DURING DEFENSIVE.** In general the allocation of responsibilities closely approximates that for the offensive. The principal differences are the greater emphasis on reconnaissance and observation, by both ground and air forces, and the centralized employment of the air forces, which eliminates the necessity for detailed participation of subordinate ground components in the operating plan. Another specific difference is inherent in the phases of defensive combat as compared to offensive combat. In the defense, there generally are three main phases: combat for the outpost line of resistance, combat for the main line of resistance, and counteroffensive or withdrawal operations. Alternate plans must be prepared in accordance with the main alternatives of defensive action. Provisions for the ground defense of air installations, particularly against armored break-throughs, are of special importance. The air army commander, therefore, is responsible that the commanders of subordinate air units make specific local arrangements with ground troops for the security of air installations.

**b. Coordination during combat.** In theory, two types of coordination exist between air and ground forces: air units may be attached to, or may be in support of ground units. In actual Soviet operations, attachment of air units to ground echelons below army level is becoming increasingly rare.

During the air preparation and break-through phases of an offensive operation, air units never are attached to ground units, nor is attachment common in any type of defensive operation. When air units are attached to ground units, as in the security and exploitation phases of the offensive, the ground forces commander transmits his orders directly to the air unit commander, who either is physically present at the ground commander's forward operations post or who maintains a radio contact with the ground commander.

When air units support ground units, command is retained by the air forces. The ground commander transmits his requests for air support through the air liaison officer, who is stationed at the ground unit's command post.

In other respects, the procedure of air-ground coordination during combat is identical in both support and attachment. The principal procedures involved are the dispatching of air liaison sections to ground units, the mutual briefing and detailed discussions between air and ground staffs concerned,

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the establishment of control check points and ground control stations, and the mutual evaluation of operations in progress by the cooperating air and ground staffs.

**AIR LIAISON SECTIONS.** The composition of air liaison sections varies considerably in accordance with the importance of the headquarters to which they are dispatched. Air liaison sections with major headquarters, such as tank armies, consist of the chief and several senior officers of the operations section of the supporting air forces and officers from the intelligence, meteorological, and signal sections. At lower echelons, occasionally even tank or rifle battalions, single air liaison officers may suffice.

Air army and subordinate air staffs are responsible for the provision and maintenance of adequate signal communications for air liaison sections. These sections usually operate on two nets. One permits direct transmission of requests to air units in flight. This frequency also is used by the senior air commander from his ground command post to transmit orders in the event ground unit requests must be disregarded or current missions changed. The other net, wire and radio, connects the air liaison section directly with the commander of the air unit. When air and artillery are cooperating, the artillery commander receives on the frequency used by the air liaison officer to communicate with aircraft in flight.

During the initial phases of air preparation for all offensive and defensive operations, command of all units in flight is centralized directly at the air army command post. Communications between units in flight and air liaison officers are not maintained, except by special authority of the air army commander. Instead, all air liaison officers and the air army command post maintain a separate single intercommunication net. Thus, the air army is kept abreast of the needs of all ground units and also can relay to ground units such information concerning the massed employment of aviation as may be necessary.

The missions of air liaison sections include the relaying not only of requests for air support, but also of information to the cooperating commanders on major changes in the air and ground situations.

**GROUND CONTROL STATIONS.** All ground and air commanders share the responsibility for the establishment and proper operation of an adequate net of ground control stations. The primary missions of

these stations are to control the flight of friendly aircraft, particularly with regard to air and ground safety; to inform them of major changes in the tactical situation; to retransmit requests and orders when necessary; and to warn both aircraft in flight and ground units of the approach of enemy aircraft.

Ground control stations may be classified as base and as auxiliary stations. Base stations are equipped with radar and are under the direct control of the senior commanders of air formations and units in an operation. From these base stations, senior commanders can change targets, regroup tactical formations, summon reinforcements, cancel attacks, or stipulate the number of attacks to be made. Auxiliary stations control aircraft only so far as is essential for air or ground safety. They generally are provided with visual and auditory observation facilities.

Each ground control station includes representatives of the operations section of the ground forces operating in the sector and an air staff, headed by a senior officer. The station consists of an air observation net, a signal and operations center, and an aircraft control check point, which is a terrain feature easily recognizable from the air. Ground staffs are responsible for providing adequate signal communications from ground control stations to ground units. Air staffs are responsible for communications to air units.

**AIR WARNING.** Throughout World War II, the Red Army maintained an efficient air observation and warning system. This function is one of the most important responsibilities of all operations staffs, at each level of command, for both ground and air forces. Although the facilities include army group and air army radar units, the air warning system is dependent fundamentally on a comprehensive net of visual and auditory observers from every military or civilian unit and installation. For example, during the war every group of 300 civilians was required to maintain a detachment of at least six observers.

Air warning reports are transmitted either directly to all headquarters over a reserved frequency to which all command posts constantly are tuned, or through control stations of the rear areas and the zone of the interior observation nets. Key observation posts are provided with duplicate radio and wire facilities. Reports of immediate value to aircraft in flight are relayed to them by the ground con-

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trol stations. Aircraft in flight report the approach of enemy aircraft to the same stations, which immediately relay the information through air warning channels.

### 3. COMMAND OF AIR ARMY OPERATIONS

**a. Air army staff procedure.** The procedures of the air army staff briefly are as follows:

**FORMULATION OF PLAN.** The army group staff must give advance warning to the air army staff of the impending issue of combat orders for an operation and by what means they will be transmitted. Upon receipt of these warning orders, the operations duty officer reports immediately to the chief of staff and to the chief of the operations section. If the field order is to be transmitted by telephone, telegraph, or radio, the Chief of staff must insure that all channels involved in the transmission are ready. In addition, he alerts the chief of the Rear Services to assure an adequate supply of fuel, ammunition, and rations for the impending operation.

Upon receipt of the field order, the air army commander must make a personal study of his own forces and of the ground and air situation before making his decisions. To assist him, the chief of staff directs the chiefs of staff sections and services to prepare a short staff estimate. The short staff estimate consists of: an estimate of time available to the commander and his staff for making a decision, allowing a maximum of time for the transmission of orders and the preparation of the air army for the impending operation; information concerning the enemy, such as advanced ground troops, artillery, reserves, where, when, and by whom enemy antiaircraft artillery was observed, types and numbers of enemy planes noted and the character of their activity, system of antiaircraft defense on the front line and in the immediate rear; information concerning own troops, such as disposition, time schedules, objectives, and methods by which friendly aviation can assist; detailed combat missions of adjacent air armies, if available; status of personnel and matériel, such as number of units available for combat, number of aircraft available, condition of matériel, technical provisions; weather conditions at airfields and in the area of the intended operation, with a forecast for the duration of the operation; status of preparation of the aircraft for flight; and preliminary navigation and bombing charts, including distances to objectives, duration of flights, amount of fuel and lubricants needed for operations against

objectives, permissible loads of bombers, and types and calibers of bombs.

The work of individuals on the air army staff is as follows:

The *Chief of the Operations Section*, after issuing the warning orders to the air units, prepares the time schedules, information regarding units, and brings the situation map up to date.

The *Intelligence Officer* prepares a large-scale map of the enemy area and marks the objectives. He posts the latest information regarding the distribution and combat activities of enemy fighters, anti-aircraft artillery, and other air defenses on the reconnaissance map and prepares the first paragraph (information concerning the enemy) of the field order. He dispatches orders to reconnaissance units.

The *Sturman* prepares the navigation chart, orders a weather forecast for the operation, and prepares preliminary navigation estimates for the operation.

The *Chief of Signal Communications*, on the basis of instructions received from the chief of the air staff, prepares the signal communications order (annex).

The *Chief of the Rear Services* prepares information regarding the requirements and reserves of fuel, ammunition, and rations needed for the operation and information regarding the drawing of supplies.

The *Chief of Staff*, with the assistance of his staff, prepares several alternate plans, if time permits, and submits them to the commander. In addition, he must be ready to advise the commander on the following: time remaining for the air army to prepare for the operation; time remaining for the air army commander to make his decision and to issue the order; contents of the field order received; objectives; aviation strength required; time of attack; number of air units available; description of objectives, accompanied by large-scale maps, photographs, or other means of identification; types and weights of bombs required to accomplish missions; anticipated countermeasures of the enemy air force in the area of operations; location of friendly front line and troops; condition and composition of own units; and preliminary estimate composed by the air staff.

**THE FIELD ORDER.** The field order is drawn up after the commander makes his decision. To expedite the preparation of the field order, the chief of staff and the responsible heads of sections and staff departments are present at the command post while the commander is making his decision. The opera-

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tions officer takes down the verbal order of the commander. The assistant operations officer posts it on the map. The Chief of Staff instructs the operations officer in what sequence, to whom, and by what means the preliminary orders will be issued.

The Operations Officer then prepares a draft of the field order, a maneuver chart of the area of operation, coordinates all communications problems and a signal table with the Chief Signal Officer. The Intelligence Officer prepares the reconnaissance order and, after it is signed by the Chief of Staff, issues it to the subordinate staffs. The Chief Signal Officer prepares the signal order (annex). The *Sturman* prepares the navigation plan and, together with the Signal Officer, assists in the preparation of the signal order and the coded maps. Together with the Chief Engineer Officer, *Sturman* determines the most advantageous use of aircraft by types. With the Operations Officer, *Sturman* prepares the table for the coordination of the attack.

The Chief of the Rear Services, together with the Chief Engineer, estimates the requirements for fuel, lubricants, ammunition, and other supplies needed for the operation and submits it to the section for rear organization. In addition, he writes the field order (annex) for the rear organization and submits it to the commander and the chief of staff for signature. The Chief of Staff supervises, checks, and coordinates all documents and annexes, reports the draft of the field order and the order for the rear organization, approves instructions for the reconnaissance and navigation services, the signal annex, and the bombing table.

After the field order is signed by the air army commander, the operations officer dispatches copies and attached documents to the subordinate units and to commanders of all ground units directly concerned. Excerpts from the reconnaissance annex and instructions are dispatched by the intelligence officer to subordinate units, adjacent staffs, and to staffs of reconnaissance units.

The field order usually is transmitted by telephone and in written form. If time permits, the order may be issued through personal contact between the commander and subordinate commanders. Personal contact adds special importance to the missions assigned and allows for quick last-minute changes as the situation demands. Telephone, telegraph, and radio are used to report and receive instructions.

ASSIGNMENT OF MISSIONS. The assignment of

combat missions to air units depends upon the types of missions, the time in which they are to be accomplished, and the number and location of units available for the operation. The air division usually is assigned missions requiring from 1 to 3 days to accomplish. However, it may be assigned missions requiring 1 day or even one flight.

**b. Responsibilities of lower air staffs.** Staffs of all subordinate air formations and units are charged specifically with insuring that all flight personnel are provided with adequate large-scale maps and aerial mosaics. They must check the familiarity of the air crews with the friendly and enemy situation in the zone of operations, with ground control stations, with established signal operating instructions (particularly for air-ground coordination), and with the major terrain features in the zone of projected operations. They are responsible for insuring direct staff discussions with the supported ground units and, when time permits, for personal ground reconnaissance (particularly to establish the locations of friendly and enemy front lines). If time is available, training exercises must be planned and executed in advance of the operation to insure precise time and space coordination with ground troops.

**c. Control of staffs during combat.** Because of the sudden change in tactical and meteorological conditions inherent in air operations, close command and staff control is essential during all phases of combat. Air army and subordinate staffs are manned adequately to provide alternate plans on short notice. Control of subordinate units is maintained through tours by commanders and staffs and through base ground control stations.

#### 4. CONDUCT OF AIR ARMY OPERATIONS

**a. The offensive.** Offensive operations generally include four phases.

**AIR PREPARATION.** The duration of air operations in preparation for a ground offense may vary from several weeks to days, hours, or even minutes. Conditions which exclude the necessity of a long air preparation include: a stable front, complete air superiority, and comparative weakness of the enemy in reinforcements and supply. If a lengthy air preparation is necessary, the principal objectives are the physical exhaustion and lowering of the morale of enemy troops, disruption of enemy construction of defense positions, and the reduction of effectiveness

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of enemy weapons. These missions are accomplished by continuous and systematic action of the air force, both day and night, against combat formations, against the hostile main lines of resistance and positions deeper in the defensive zone, against fortifications and artillery positions, and against reserves.

Air activity is conducted over a wide front, to avoid disclosure of the direction of the main effort. Immediately before the launching of the ground offensive, the air preparation ends with a mass attack of large air formations in the direction of the main effort.

This mass attack can be conducted before, during, or after the main artillery preparation. In this phase, the entire air army is concentrated in the direction of the main effort, and has as its main objectives artillery and mortar positions, antitank guns, and tactical ground reserves. If the air preparation is conducted after the artillery preparation and immediately before the infantry assault, the main objectives of aviation are the destruction of personnel and firing positions in the enemy main line of resistance. This mass attack consists of a series of successive attacks at 5-, 10-, and 15-minute or, sometimes, less frequent intervals.

The saturation bombardment in the direction of the main effort may reach as high as 120 tons per 1,000 square yards marked for the break-through. The location, time, and height at which each attack wave is to cross the friendly front line must be communicated in advance to the artillery, which can then shift or cease fire as needed.

**THE BREAK-THROUGH.** Air support during the assault and break-through consists of periodic attacks on the enemy artillery positions, mortar batteries, and antitank weapons which are impeding the advance of friendly troops. It also serves to disorganize enemy counterattacks and to provide cover from enemy air action.

Covering aircraft must patrol constantly over the area of combat to observe changes in the ground situation. They must be ready to support ground troops by bombing and strafing on call. The action of aviation over the battlefield is continuous until the objective is taken and consolidated.

**SECURING THE OFFENSIVE.** During this phase, air operations continue substantially as in the break-through period. Certain complicating factors must, however, be taken into account. Ground maneuver deviates increasingly from the original plan. Con-

sequently, the problem of identifying friendly units becomes increasingly important.

As ground forces advance deeper into enemy territory, active enemy antiaircraft weapons appear in large numbers. Long range counterbattery operations by the artillery are, therefore, of critical importance to avoid excessive losses of aircraft. In addition, enemy operational and strategic reserves, both ground and air, may be anticipated. As a result, strong air forces must be available on ground alert at nearby airfields to intervene in event of sudden changes in the situation. Coordination between advanced and succeeding echelons of ground forces and their supporting aircraft must be insured. Finally, the increasing dispersion of ground troops and the commitment of mobile forces necessitates increasing decentralization and partial change from direct support to attachment of air units to ground units.

**EXPLOITATION.** Exploitation of the break-through by the ground forces consists of the simultaneous pursuit of withdrawing enemy forces and the destruction of encircled remnants. In this complicated situation the air forces cannot be dispersed regardless of requests from ground commanders. All efforts must be directed to support the main objective of the army group commander.

Normally this objective will be the continued advance of the mobile forces. To accomplish this, mass attacks are made on key enemy reserve positions, and, at the same time, air units provide continuous fighter cover for the mobile formations. Small groups of fighter or ground attack aircraft fly ahead of the mobile troops to reconnoiter, to neutralize enemy antitank defenses, and to provide continuous cover. Air-ground communications are maintained primarily by radio, in the clear, although signal rockets and other supplementary means also are employed.

In order to maintain the continuity of the air effort in the pursuit of retreating enemy forces, airfield construction battalions allocated by the air army advance with the second wave of mobile troops to prepare airfields as directed. The use of aviation against encircled enemy troops is a secondary mission in exploitation and is undertaken only when the encircled troops attempt to break out of the encirclement in conjunction with enemy counterattacks.

**b. The defense.** In the defense, all aviation is centralized fully under the air army commander.

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Until the mass commitment of the air army is directed by the army group commander, the primary missions of the air forces include patrolling, observation, and harassment.

Aircraft must report the locations of important targets directly to artillery units. Massed aerial counterattacks are initiated either in conjunction with the artillery counterpreparation to destroy enemy fire, immediately before the enemy attack, or after the enemy break-through and just prior to the friendly counterattack. During air operations, the support of friendly antiaircraft artillery is vital.

During withdrawals, the air force's main mission is to cover ground formations. Special air formations are detailed, and may be attached to the rear guard ground commander. Because the ground situation is changing constantly in withdrawals and orders often are interrupted in transmission, mutual recognition and mutual target designation between air and ground units is of decisive importance. The air army commander personally is responsible for providing maximum support to rear guards. All aircraft of the air army, regardless of assigned missions, may be diverted to cover withdrawing ground forces.

### Section III. FIGHTER METHODS AND TACTICS

#### 1. GENERAL

Methods and tactics depend on a great number of variable factors. What is good today may be useless tomorrow. What is not warranted in the first phase of a war may find justification in a later stage. The methods and tactics presented emerged from World War II. Exactly what effect future developments in aircraft and equipment will have on them is not known at present.

#### 2. RED ARMY AIR FORCE FIGHTERS

The missions of fighter units of the Red Army Air Force are to protect troops and installations from enemy air attack; to destroy enemy aircraft, both in the air and on airfields; to destroy enemy troops; to escort ground attack and bomber aircraft; to conduct aerial reconnaissance; and, as is true with all Soviet aviation, to support the Red Army in all operations.

**a. Location of fighter bases.** The Soviets advocate basing fighter units close to the front line. During an offensive operation, the main fighter con-

centration is based in a zone from 18 to 20 miles in depth running parallel to and 6 miles from the front line. Normally, one fighter regiment occupies one airfield. This method of dispersal may, of course, be abandoned in the event sufficient fighter fields are not available or bad weather results in poor airfield serviceability. As changes in the front line occur, fighter units are shifted accordingly.

In an offensive, airfield engineer battalions move with mobile formations. Many instances have been reported in which fighter units occupied airfields before the arrival of infantry. Protection for these units was provided by tank detachments until the infantry arrived. This factor, along with the small airfields from which Soviet fighters can operate, makes the fighter force outstandingly mobile.

During defensive operations, the main fighter concentration is dispersed on airfields distant from the front line. Small groups of fighters, however, are kept on forward bases for advance defensive patrols and interception. To minimize losses from enemy air attack, these small groups are shifted from one field to another, either early in the morning or late in the evening. Other forward bases also are maintained and, although not occupied, are available for projected operations. Supplies are brought in at night. Fighters move up from the rear to the forward bases, where they are refueled, and then take off against the enemy. In the event of a counterattack by the ground forces, the main fighter concentration is moved quickly from the rear area to the forward bases to provide immediate and direct support to the ground forces.

**b. Tactical units.** The basic tactical unit of any Soviet fighter formation is a *Para*, or element consisting of two aircraft (fig. 11).

A *Gruppa* is the largest tactical unit, and usually consists of from six to eight aircraft. The nucleus of a *Gruppa* is a *Zveno* (flight) of two *Paras* totaling four aircraft (fig. 12).

A *Gruppa* of six aircraft consists of one *Zveno* and one independent *Para*, but the eight-plane *Gruppa* is made up of two complete *Zvenos*.

Because the majority of Soviet fighter sorties are for escort or patrol duties, the formations for these operations may be considered typical. The main characteristics of these formations are greater spacing of *Paras*, both horizontally and in altitude, and the "stacking up" of subordinate aircraft in respect

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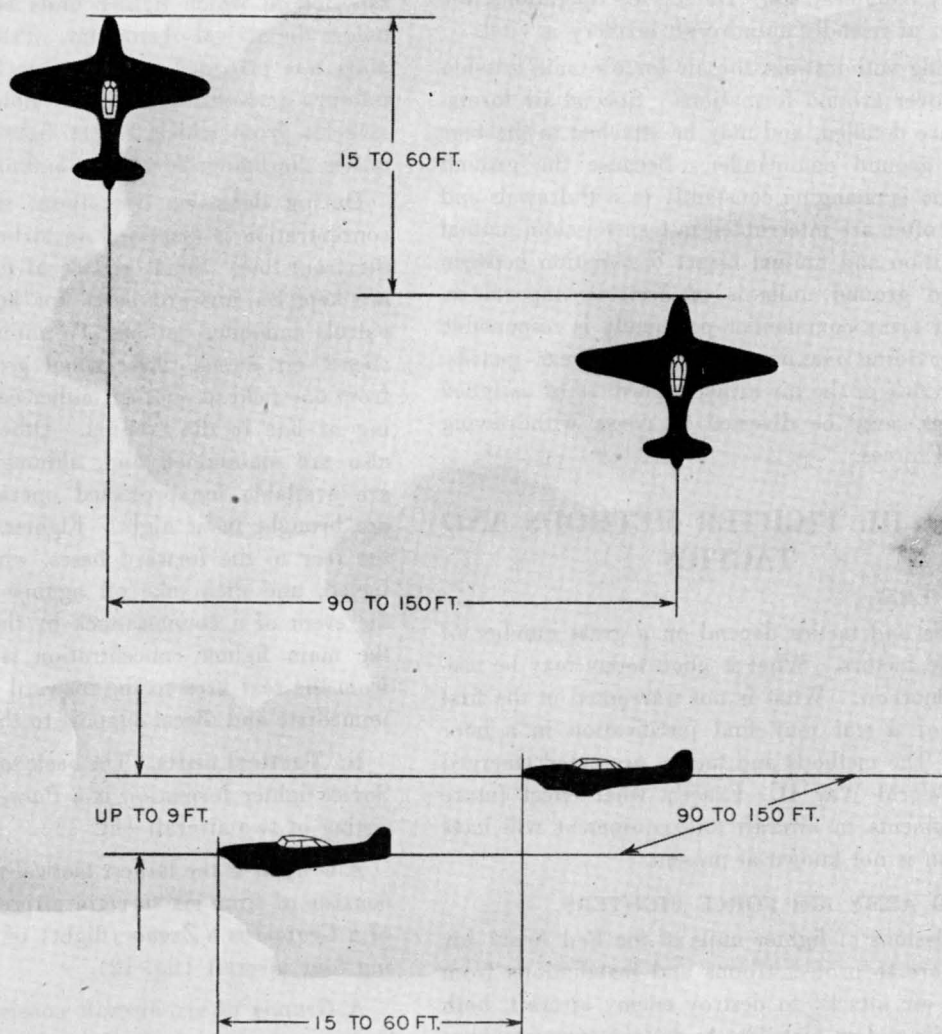


Figure 11.—Typical Para formation.

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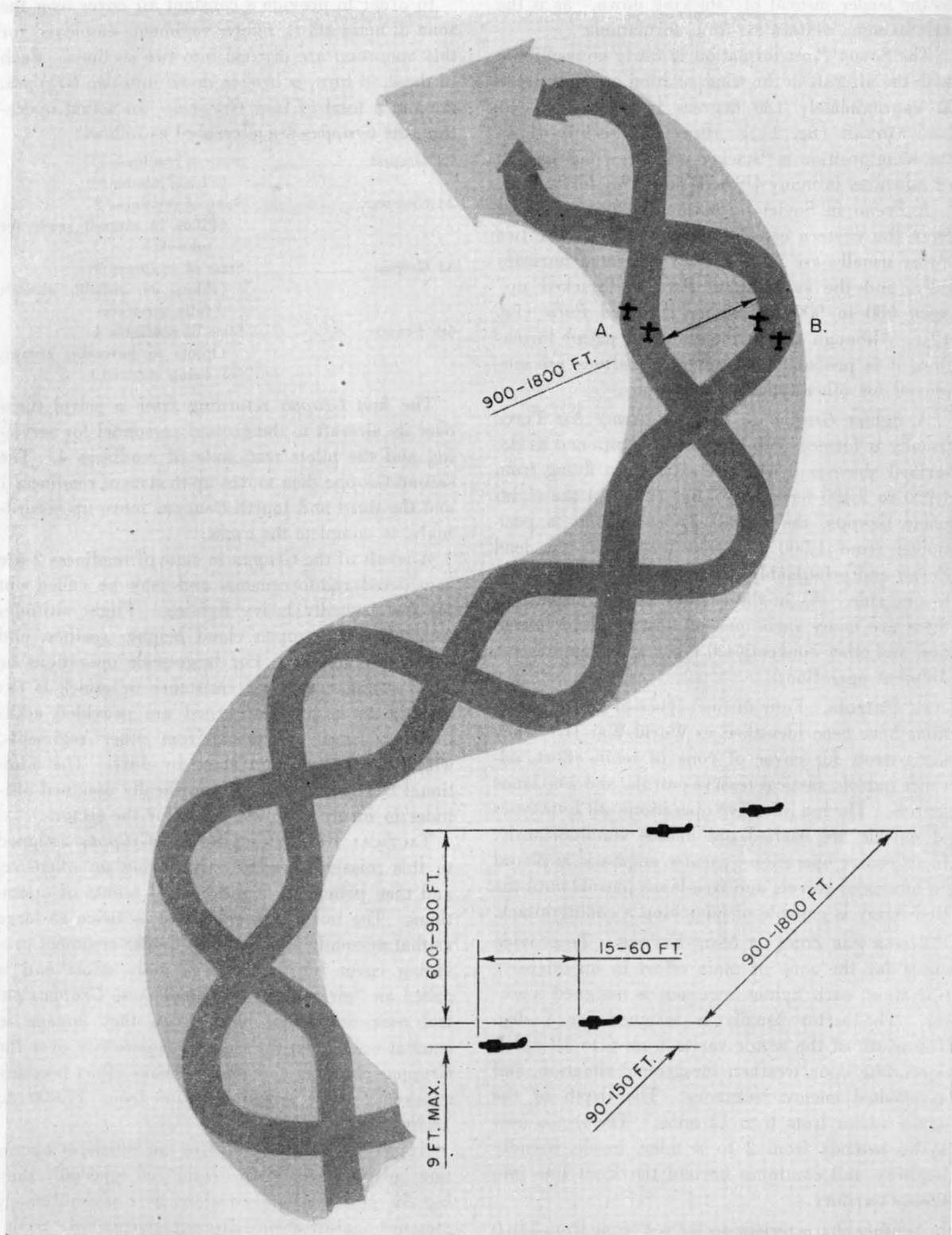


Figure 12.—Typical Zveno formation.

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to the leader instead of "stacking down," as is the case in some western air force formations.

The Soviet *Para* formation is fairly conventional with the aircraft in the wing position out to the side at approximately 120 degrees in relation to the lead aircraft (fig. 11). However, the aircraft in the wing position is "stacked up" a few feet instead of down, as in many USAAF and RAF formations.

A *Zveno* in Soviet formations is quite different from the western conception of a flight. The two *Paras* usually are more widely separated horizontally, and the subordinate *Para* is "stacked up" from 600 to 900 feet above the lead *Para* (fig. 12). Although this is the standard patrol formation, it is probable that other formations are employed for other types of operations.

A fighter *Gruppa* in the Red Army Air Force usually is formed with one *Zveno* positioned as described above and with the extra *Para* flying from 1,200 to 2,400 feet above (fig. 13). In the eight-plane *Gruppa*, the second *Zveno* usually is positioned from 1,000 to 2,000 feet above the lead *Zveno* and presumably at a reasonable distance out to one side. As in the case of *Zveno* formations, there are many variations of this standard formation and other conventional types of formations for different operations.

**c. Patrols.** Four distinct types of patrol operations have been identified in World War II. They are patrols for cover of zone of main effort, advance patrols, tactical reserve patrols, and free lance patrols. During offensive operations, all four types of patrols are carried out almost simultaneously. In defensive operations, greater emphasis is placed on advanced patrols and free-lance patrols until the Red Army is capable of launching a counterattack.

**COVER FOR ZONE OF MAIN EFFORT.** To provide cover for the zone of main effort in an offensive operation, each fighter regiment is assigned a sector. The sector usually is assigned for 1 day. The width of the sector varies from 6 to 18 miles, depending upon weather, the ground situation, and anticipated enemy resistance. The depth of the sector varies from 6 to 12 miles. The sector normally extends from 2 to 3 miles inside friendly territory and continues beyond the front line into enemy territory.

Another characteristic sector is a circle from 3 to 6 miles in diameter. It is used when river crossings or other special operations are covered.

In order to provide a constant air cover over the zone of main effort, fighter regiments employed for this operation are divided into two sections. Each of these, in turn, is broken down into two *Gruppas*, making a total of four *Gruppas*. In actual operation, the *Gruppas* are alternated as follows:

- |                         |  |
|-------------------------|--|
| 1st <i>Gruppa</i> ----- | State of readiness 1<br>(Flying mission.)                              |
| 2d <i>Gruppa</i> -----  | State of readiness 2<br>(Pilots in aircraft ready for take-off.)       |
| 3d <i>Gruppa</i> -----  | State of readiness 3<br>(Pilots on airfield, aircraft fully serviced.) |
| 4th <i>Gruppa</i> ----- | State of readiness 4<br>(Pilots in barracks, aircraft being serviced.) |

The first *Gruppa* returning from a patrol turns over its aircraft to the ground personnel for servicing and the pilots rest, state of readiness 4. The second *Gruppa* then moves up to state of readiness 1 and the third and fourth *Gruppas* move up accordingly, to complete the cycle.

Aircraft of the *Gruppa* in state of readiness 2 are considered reinforcements and may be called out for unexpectedly heavy fighting. Flight altitudes vary, depending upon cloud height, weather, and enemy air activity. For large-scale operations or when strong enemy air resistance or attack is expected, the sectors concerned are provided additional cover by *Gruppas* from other regiments, which are on constant stand-by duty. The additional *Gruppas* operate at specifically assigned altitudes to insure complete cover for the sector.

**TACTICAL RESERVE PATROLS.** *Gruppas* assigned to this mission operate only during an offensive, and then primarily at the critical points of operations. The normal patrol sector is twice as large as that normally assigned to a fighter regiment providing cover for the zone of main effort and is called an "air zone." Although these *Gruppas* patrol over the actual battle area, they engage in combat only when the enemy's superiority over the *Gruppas* covering the zone of main effort becomes apparent. The patrols operate from 17,000 to 18,000 feet.

**ADVANCE PATROLS.** During an offensive operation, advance patrols are employed especially during the period of preparations as a precautionary measure against enemy aircraft, particularly reconnaissance aircraft, penetrating to the zone of main effort. Advance patrol sectors are two to three

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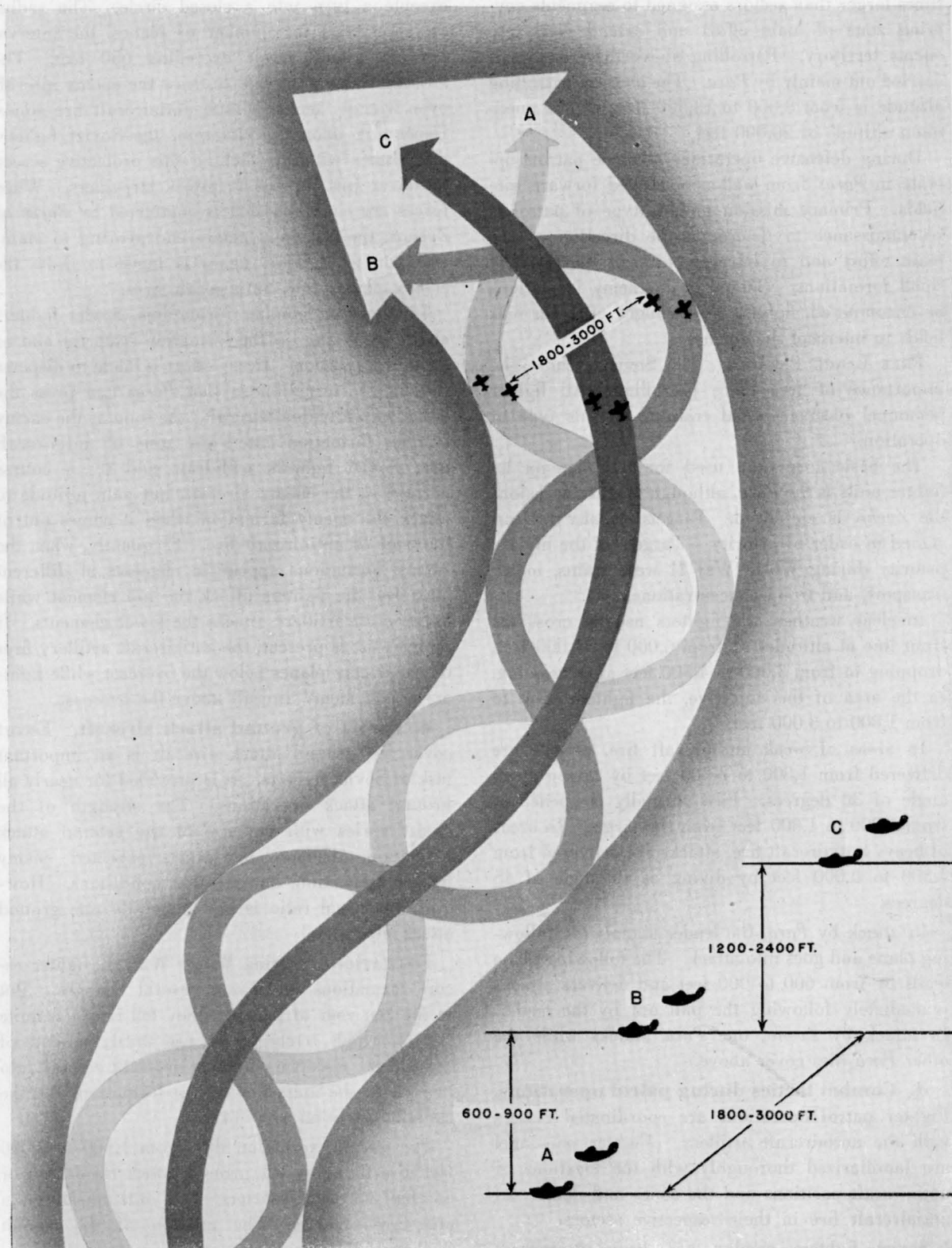


Figure 13.—Typical Grappa formation.

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times larger than sectors assigned to regiments covering zone of main effort and extend deep into enemy territory. Patrolling above these sectors is carried out mainly by *Para*. The average patrolling altitude is from 8,000 to 13,500 feet, with a maximum altitude of 20,000 feet.

During defensive operations advance patrols operate in *Paras* from well-camouflaged forward airfields. Primary mission on this type of patrol is reconnaissance to determine the direction of the main effort and to intercept aircraft, particularly small formations. Should large enemy formations be encountered, fighters are brought up from rear fields to intercept the enemy.

**FREE LANCE PATROLS.** The Soviets realize the importance of free lance patrolling. All fighter personnel receive special training in this type of operation.

The basic formation used for free lancing by fighter units is the *Para*, although on rare occasions the *Zveno* is employed. Targets usually are assigned in order of priority. Targets of the highest priority during World War II were trains, motor transport, and troop concentrations.

In clear weather, the fighters usually cross the front line at altitudes of from 6,000 to 12,000 feet, dropping to from 3,000 to 4,500 feet after crossing. In the area of the objective, the fighters drop to from 1,800 to 3,000 feet.

In areas of weak antiaircraft fire, attacks are delivered from 1,800 to 3,000 feet by diving at an angle of 30 degrees. Fire normally is opened at from 1,200 to 1,800 feet from the target. In areas of heavy antiaircraft fire, attacks are delivered from 4,500 to 6,000 feet by diving at an angle of 45 degrees.

In attack by *Para*, the leader signals the following plane and goes into attack. The following plane trails by from 600 to 900 feet and delivers attacks immediately following the pull out by the leader. In attack by *Zveno*, one *Para* attacks while the other *Para* flies cover above.

#### **d. Combat tactics during patrol operations.**

Fighter patrol operations are coordinated closely with the antiaircraft artillery. Fighter personnel are familiarized thoroughly with the locations of antiaircraft positions and the zones and density of antiaircraft fire in their respective sectors.

Soviet fighters employ two basic maneuvers against enemy fighters. When outnumbered, they

execute a turn into a closed circle. The radius increases with the number of planes, the interval between planes never exceeding 650 feet. The circling fighters attempt to draw the enemy aircraft over friendly territory into antiaircraft fire zones. Depending upon the situation, the Soviet fighters then either withdraw behind this protective screen or hover just outside to attack stragglers. When forces are equal, combat is conducted by *Paras* or *Zvenos*, the attacking planes endeavoring to maintain contact. Effort again is made to draw the enemy planes into antiaircraft fires.

In attacking bomber formations, Soviet fighters attack by diving on the formation from the sun or a cloud formation. Every effort is made to disperse the enemy formation so that *Paras* can press the attack on individual aircraft. As soon as the enemy bomber formation enters the zone of antiaircraft fire, Soviet fighters withdraw and fly a course parallel to the enemy aircraft, but gain altitude to attack the enemy formation when it comes out of the zone of antiaircraft fire. Frequently, when the enemy formations appear in elements at different altitudes, the fighters attack the top element while antiaircraft artillery attacks the lower elements. If an overcast is present, the antiaircraft artillery fires on the enemy planes below the overcast while fighters attack enemy aircraft above the overcast.

**e. Escort of ground attack aircraft.** Escort cover for ground attack aircraft is an important task of Soviet fighters. It is provided for nearly all ground attack operations. The strength of the escort varies with the size of the ground attack formation, distance to target, expected enemy fighter opposition, and weather conditions. However, the usual ratio is one fighter to one ground attack aircraft.

**FORMATION.** During World War II, fighter escort formations underwent several changes. But in the last year of the war, they fell into a definite system which remained in use until the end of hostilities. Escorting fighters are split equally into two parts: the immediate escort formation, and the assault formation (fig. 14).

The assault formation flies from 1,500 to 3,000 feet directly above the ground attack formation, or one-half to three-quarters of a mile ahead on a criss-cross course. The mission of the assault formation is to prevent enemy aircraft from reaching the ground attack formation. Frequently, one

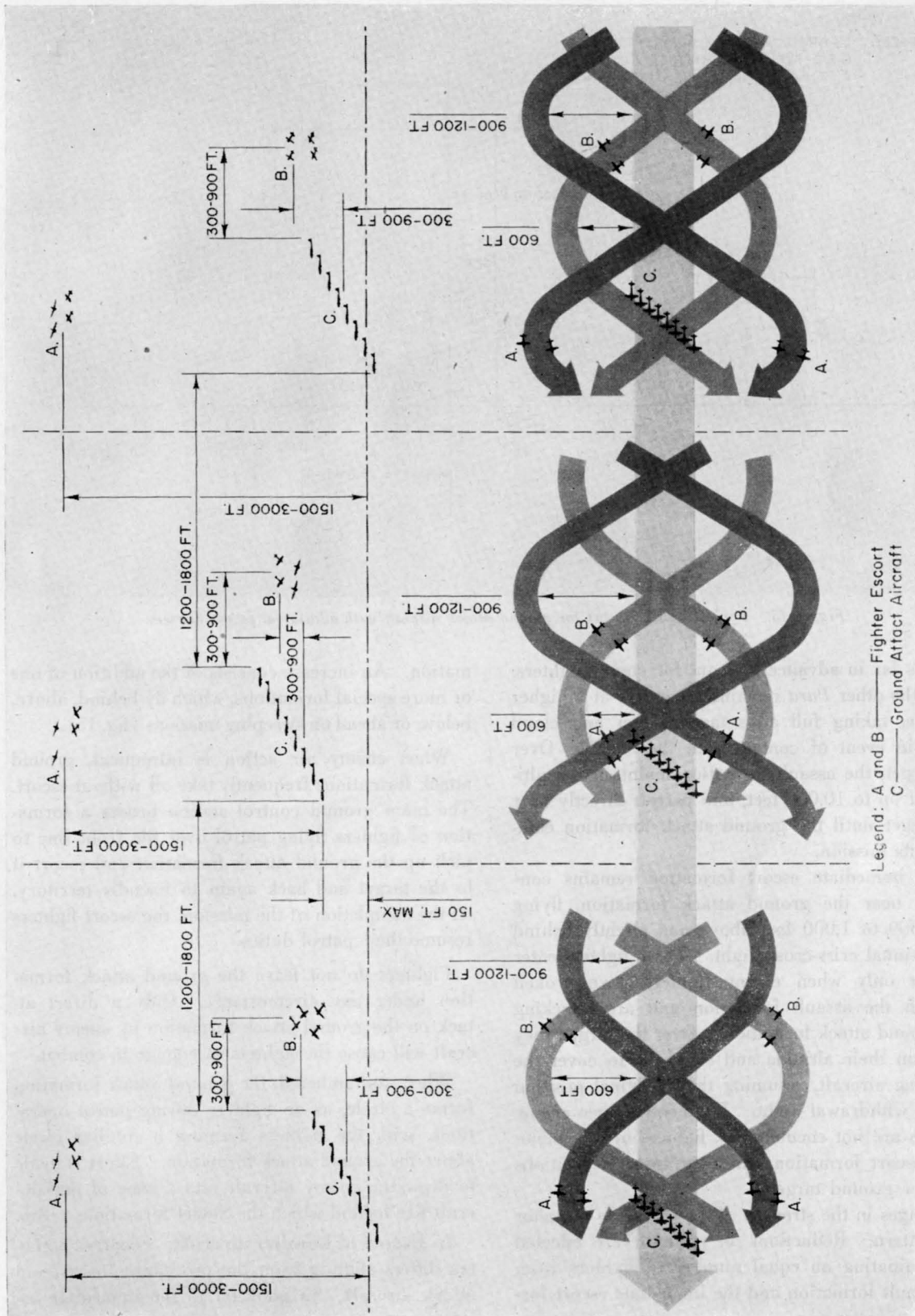


Figure 14.—Typical fighter escort formation for ground attack formation.



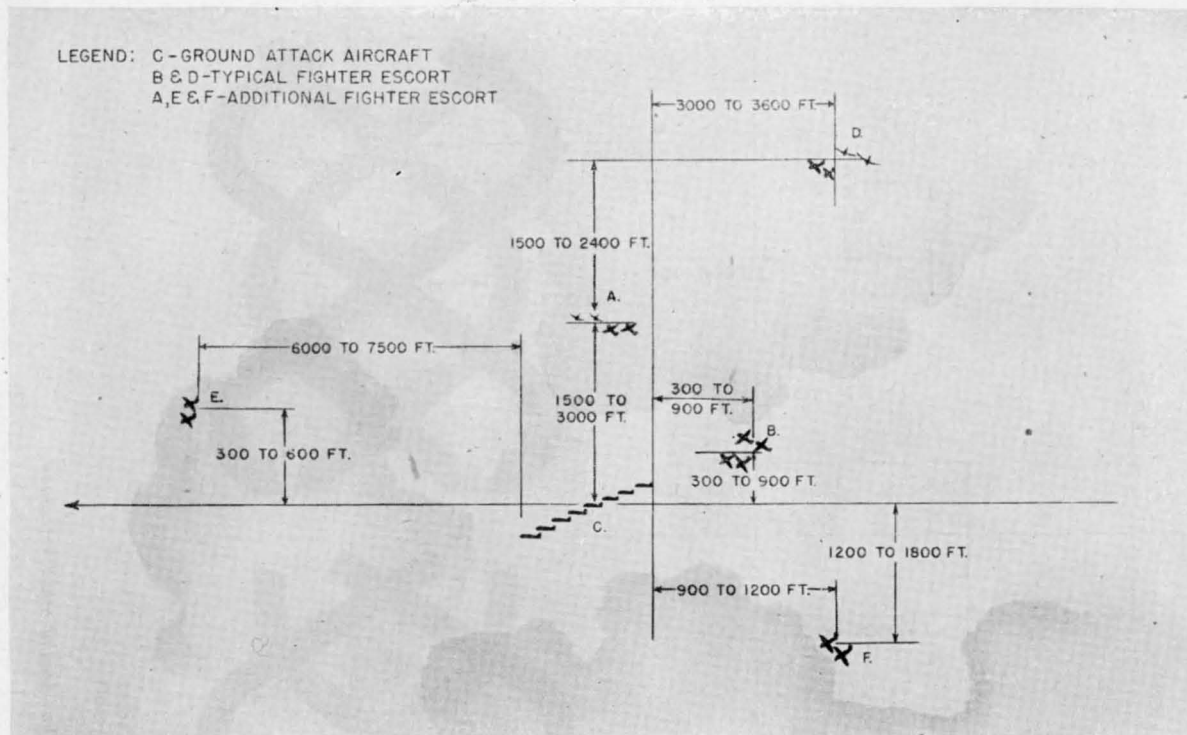


Figure 15.—Typical fighter escort for ground attack aircraft with additional escort fighters.

*Para* is far in advance to scout for enemy fighters, while the other *Para* remains in reserve at a higher altitude, taking full advantage of sun and cloud cover in event of contact with the enemy. Over the target, the assault formation maintains an altitude of up to 10,000 feet, and patrols directly over the target until the ground attack formation completes its mission.

The immediate escort formation remains constantly near the ground attack formation, flying from 300 to 1,000 feet above and slightly behind in continual criss-cross flight. These fighters enter combat only when enemy fighters have broken through the assault formation and are attacking the ground attack formation. Over the target, they maintain their altitude and stand by to cover the attacking aircraft, resuming their original position for the withdrawal flight. Frequently, when enemy fighters are not encountered, fighters of the immediate escort formation attack antiaircraft positions or other ground targets.

Changes in the strength of the escort do not alter the pattern. Reductions in strength are effected by eliminating an equal number of fighters from the assault formation and the immediate escort for-

mation. An increase consists of the addition of one or more special formations, which fly behind, above, below, or ahead on sweeping missions (fig. 15).

When enemy air action is infrequent, ground attack formations frequently take off without escort. The main ground control station orders a formation of fighters flying patrol over the front line to pick up the ground attack formation and escort it to the target and back again to friendly territory. At the completion of the mission, the escort fighters resume their patrol duties.

Fighters do not leave the ground attack formation under any circumstance. Only a direct attack on the ground attack formation by enemy aircraft will cause the fighters to engage in combat.

When outnumbered, the ground attack formation forms a circle, as do fighters during patrol operations, with the fighters forming a similar circle above the ground attack formation. Effort is made to draw the enemy aircraft into a zone of antiaircraft fire behind which the Soviet formations retire.

**f. Escort of bomber aircraft.** Escort of bombers differs slightly from the procedure for ground attack aircraft. In addition to the immediate es-

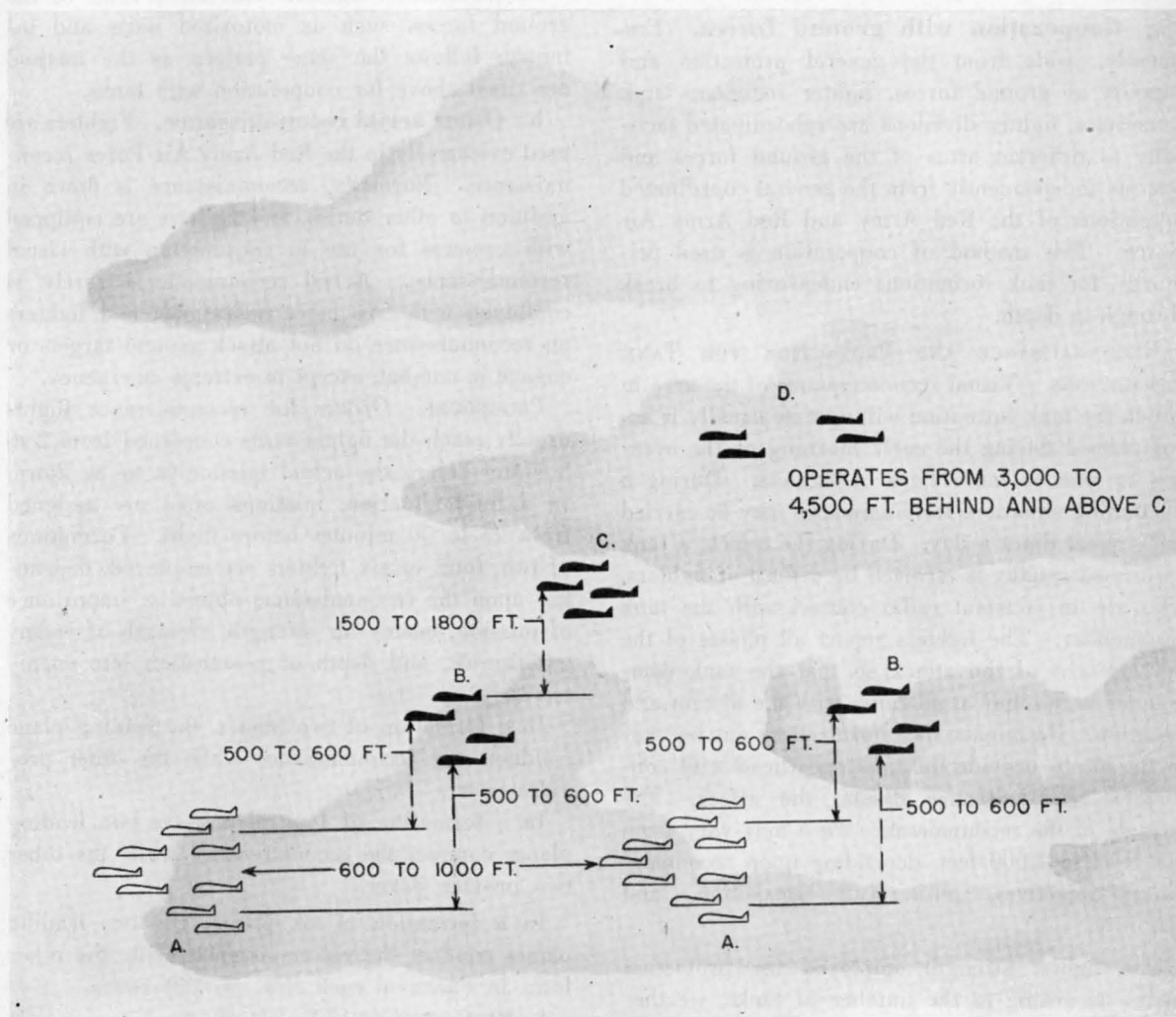
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cort formation and assault formation, an independent combat formation is provided (fig. 16).

The immediate escort formation usually consists of from four to six aircraft and flies close to the bomber formation. Disposed in *Paras* on the flanks of the bomber formation, the immediate escort formation repels attacks of enemy aircraft on the bombers. Frequently, when six aircraft are

employed, a *Para* of fighters flies below the bomber formation to cover the zone poorly protected by the bombers' guns. The immediate escort formation remains with the bomber formation, and at no time leaves the bombers to pursue the enemy.

The assault formation, following from 1,500 to 1,800 feet above the immediate escort formation, engages enemy aircraft in combat.



LEGEND: A-BOMBERS IN "V" FORMATION  
 B-IMMEDIATE ESCORT FORMATION (FIGHTERS)  
 C-ASSAULT FORMATION (FIGHTERS)  
 D-INDEPENDENT COMBAT FORMATION (FIGHTERS)

Figure 16.—Fighter escort for bombers.

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The independent combat formation has a large degree of freedom of action. Upon nearing the target, this formation leaves the main formation to reach the target from 2 to 3 minutes before the bombers. The mission of the independent combat formation is to find and engage enemy planes. Upon the arrival of the main formation, the assault formation assists the independent combat formation.

**g. Cooperation with ground forces.** Frequently, aside from the general protection and support of ground forces, fighter regiments and, sometimes, fighter divisions are subordinated tactically to different arms of the ground forces and operate independently from the general coordinated operations of the Red Army and Red Army Air Force. This method of cooperation is used primarily for tank formations endeavoring to break through in depth.

**RECONNAISSANCE AND PROTECTION FOR TANK FORMATIONS.** Visual reconnaissance of the area in which the tank formation will operate usually is accomplished during the early morning or the evening by one or more *Para* of fighters. During a fluctuating situation, reconnaissance may be carried out several times a day. During the attack, a tank spearhead usually is escorted by a *Para* of fighters, who are in constant radio contact with the tank commander. The fighters report all phases of the development of the attack so that the tank commander is familiar at all times with the terrain and situation. Reconnaissance *Para* relieve one another in the air to provide the tank spearhead with continuous reconnaissance during the attack. The altitude of the reconnaissance *Para* may vary from low level to 7,000 feet, depending upon reconnaissance objectives, antiaircraft opposition, and visibility.

The fighter strength employed for protection varies according to the number of tanks, weather conditions, and the strength of enemy air opposition. Taking as an example a *Gruppa* of eight aircraft, the formation would be as follows:

Section 1—a *Para* ranging from 1,000 to 5,000 feet.

Section 2—a *Zveno* ranging from 6,000 to 10,000 feet.

Section 3—a *Para* ranging from 6,000 to 12,000 feet.

Sections 1 and 2 normally remain directly over the tank formation, while Section 3 covers the surrounding area in wide circles to intercept approaching enemy aircraft. If enemy aircraft are sighted, Section 3 directs the *Zveno* to the enemy by radio. Sections 1 and 3 remain in reserve. Should a large enemy air formation be encountered, Section 3 can call for reinforcements.

Cooperation of fighters with other arms of the ground forces, such as motorized units and infantry, follows the same pattern as the method described above for cooperation with tanks.

**h. Other aerial reconnaissance.** Fighters are used extensively in the Red Army Air Force reconnaissance. Normally, reconnaissance is flown in addition to other duties, and fighters are equipped with cameras for use in conjunction with visual reconnaissance. Aerial reconnaissance rarely is combined with free lance operations, and fighters on reconnaissance do not attack ground targets or engage in combat, except in extreme emergency.

**PROCEDURE.** Orders for reconnaissance flights usually reach the fighter units concerned from 2 to 3 hours before the actual mission is to be flown. In a fluid situation, missions often are assigned from 25 to 30 minutes before flight. Formations of two, four, or six fighters are employed, depending upon the reconnaissance objective, importance of mission, enemy air strength, strength of enemy antiaircraft, and depth of penetration into enemy territory.

In a formation of two planes, the leading plane conducts the reconnaissance while the other provides cover.

In a formation of four planes, the two leading planes conduct the reconnaissance while the other two provide cover.

In a formation of six planes, the two leading planes conduct the reconnaissance while the other four, in *Paras* on each side, provide cover.

**i. Night fighter tactics.** Night fighter operations are coordinated closely with antiaircraft artillery in the defense of important cities and other installations. The usual procedure is to defend the main target with a series of circular rings of antiaircraft weapons of all calibers, from 500 to 2,000 guns.

Fighters are assigned to regions, on the distant approaches to the target, outside the zone of antiaircraft fires. During World War II, these regions

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usually were marked by bonfires or other means of illumination on the ground.

Fighters are distributed at altitudes of from 6,500 to 20,000 feet, with a distance of 1,600 feet between planes at the same altitude. Thus, a large number of fighters can be put into the air, with minimum danger of collisions, to assure maximum protection from enemy aircraft.

Friendly aircraft are forbidden to fly over anti-aircraft zones, and coordination of fighters and anti-aircraft fires in the same zone at night is exceptional. The Soviets admit that this type of operation has not as yet been mastered fully.

**SEARCH FOR ENEMY AIRCRAFT.** Although Soviet operational documents stress that the basic method of directing friendly fighters against enemy aircraft is by radio used in conjunction with ground radar, the lack of radar equipment during World War II forced the Soviets to use many auxiliary methods. In addition to the basic method, fighter aircraft were aided by anti-aircraft artillery batteries, which used target spotting station data to direct fighters toward the enemy aircraft. Upon receipt of this information, fighters flew lower than the enemy aircraft and searched every dark spot against the sky. Search tactics also included observation of anti-aircraft shell bursts, bombs, and exhaust flames from the enemy planes. Ruses such as firing bursts, to obtain return fire from unseen enemy planes, were used successfully. Searchlights also were used, although prearranged zones were established so that the searching planes remained outside of the fields of anti-aircraft artillery.

Whenever possible use was made of enemy flares, dropped on the approaches to intended targets, to spot enemy aircraft. In other cases, Soviet fighters dropped their own flares. Two or three fighters, flying from 1,500 to 3,000 feet above the anticipated height of the enemy aircraft, drop flares along the expected path of enemy flight. Two or three additional planes, normally from 1,500 to 3,000 feet above the flare-dropping fighters, fly into the illuminated zone to find and attack enemy aircraft.

**NIGHT COMBAT.** In night combat, the Soviets stress the importance of a sudden initial attack. This attack is made from 60 to 200 feet behind and below the aircraft at an angle of approximately 20 degrees. Careful aiming of the first burst is emphasized. After firing, the Soviet fighter with-

draws downward to repeat the attack from another direction.

### 3. RED NAVAL AIR FORCE FIGHTERS

Generally, fighter tactics of the Red Naval Air Force are identical to those of the Red Army Air Force. Red Naval Air Force tactics are presented only for those operations in which an appreciable difference in formation or method has been discerned.

**a. Escort of ground attack aircraft.** Normally, the formation of the naval escort corresponds to the Red Army Air Force. However, this formation is altered in low level flights over the sea. The immediate escort formation and part of the assault formation fly on each side of the ground attack formation at almost the same altitude, to screen the presence of the main formation. One *Para* of the assault formation usually reconnoiters ahead of the entire formation.

**b. Escort of torpedo aircraft.** Escort fighters for this type of operation normally equal the number of torpedo aircraft, but if enemy fighters are unusually active, a ratio of 2 to 1 is used.

**FORMATION.** Normally, torpedo aircraft formations are divided into two or three subordinate groups of three, six, and, occasionally, nine aircraft. Torpedo aircraft formations approach targets at low level, with the fighters at the same altitude on both sides (fig. 17). "A" is the immediate escort formation. "B" is the assault formation. An additional *Para* of fighters, "C," included in the escort formation to take photographs, takes position as shown. Should fog over the water cause the torpedo aircraft to fly at higher altitudes, the immediate escort formation "A," remains with the torpedo aircraft, but the assault formation and the extra *Para*, "C," fly from 2,500 to 4,000 feet above the formation. If the entire flight is made at low level, the immediate escort formation, "A," climbs to from 500 to 1,500 feet when approaching the target to facilitate attack on anti-aircraft batteries. The assault formation, "B," and *Para* "C" rise to from 5,000 to 6,500 feet and patrol the area while the attack is in progress. Frequently, if the exact location of the target is not known, *Para* "C" flies ahead, locates the target, and directs the torpedo aircraft formation by radio.

**ACTIVITY OVER TARGET.** Just before reaching the target, the immediate escort formation flies ahead to attack anti-aircraft batteries. While the

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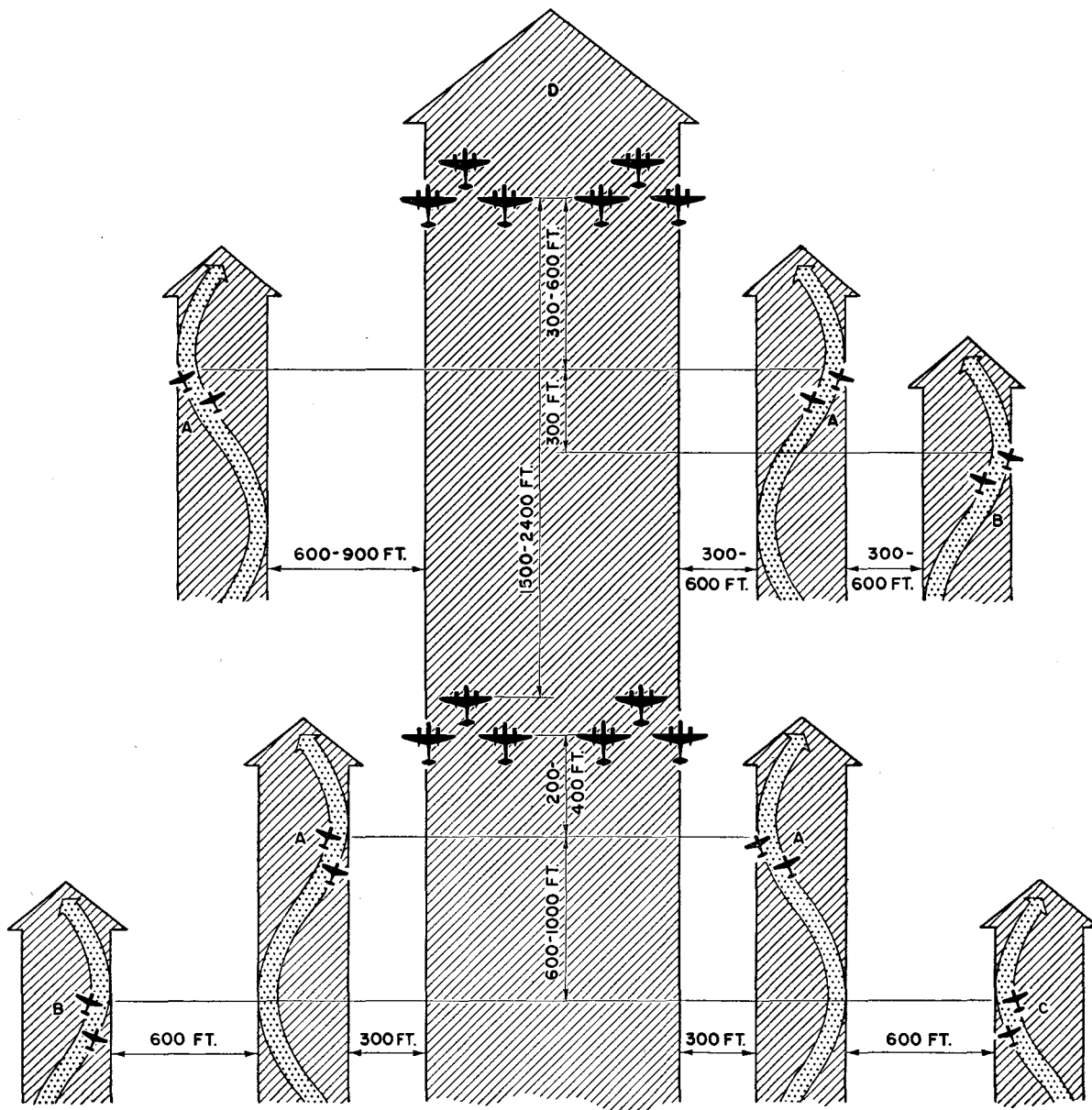
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torpedo aircraft press home their attack, the immediate escort formation prepares to protect the assembly of the torpedo attack formation for withdrawal or for a second approach, if necessary.

If a second approach is made, the immediate escort formation again attacks the anti-aircraft batteries and then covers the assembly of the torpedo aircraft. The assault group and the extra *Para*,

"C," patrol the target area to intercept enemy fighters.

When the attack is completed, the torpedo aircraft with their immediate escort withdraw at low level. The assault formation covers the rear and then loses altitude to overtake the formation. *Para* "C" remains to take photographs, withdrawing when its mission is accomplished.



LEGEND: D-TORPEDO AIRCRAFT A-B-C- FIGHTER ESCORT

Figure 17.—Fighter escort for torpedo aircraft of Red Naval Air Force.

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## Section IV. GROUND ATTACK METHODS AND TACTICS

### 1. GENERAL

The importance of ground attack aviation increased greatly during World War II, with the result that it ranks as one of the most important and effective air weapons of the U. S. S. R.

### 2. RED ARMY AIR FORCE

The primary mission of the ground attack aviation of the Red Army Air Force is to support the Red Army in all operations. It assists the artillery in the preparation for an offensive, supports the ground forces during the break-through, and covers them during disengaging operations by attacking enemy ground formations. In addition to this primary mission as "flying artillery" for the ground forces, it attacks enemy airfields, lines of communication, reserves, and performs reconnaissance.

**a. Location of bases.** During an offensive operation, the main concentration of ground attack regiments is located on airfields in a zone 30 miles in depth, parallel to and 15 miles from the front line. Units are not dispersed as widely as in the fighter force. Two or three ground attack regiments occupy the same airfield. Frequently, an airfield is occupied by a ground attack regiment and a fighter regiment for escort purposes.

In a defensive operation, small numbers of ground attack aircraft are based on forward fields for immediate support of ground forces. As is true with fighters, these planes are well camouflaged and are shifted from airfield to airfield. Supplies for the forward fields are moved in at night. For major operations, ground attack aircraft from rear fields are flown up to the forward bases, from which they operate to cover the disengagement of ground troops or to support counterattacks.

**b. Operational technique.** In World War II, ground attack aircraft operated under all types of weather conditions. Even in weather considered unsuitable for flight operation, ground attack missions were carried out without fighter escort. Only extremely unfavorable weather caused an interruption in operations.

Ground attack forces normally operated independently of other air arms, except for fighters which served principally as escort. The strength of formations, types of attack, number of attacks, target approach, and withdrawal were, as in any

other air force, governed by operational necessity.

**FORMATION AND STRENGTH.** In World War II, the usual ground attack formations employed by the Soviets were right or left echelon or the conventional four-aircraft, unbalanced "V" used by the fighters of the Western Allies. Formations of right or left echelon were made up of from four to eight aircraft.

In a concentrated attack employing a large number of ground attack aircraft, a column of from four to eight aircraft in echelon, or a variation of this arrangement, is used (A and B, fig. 18). The echelon formation probably is assumed while maneuvering for, or just prior to the actual attack. The limitations of this formation in maneuverability, defense, and its excessive demands on the pilots made it seem improbable that it was employed during the entire mission.

The echelon formation immediately prior to the attack allows ground attack aircraft to form readily into either line abreast formation for an area target, or trail formation and then, possibly, a battle circle for pin point targets (fig. 19). It is possible that the arrangement of *Zvenos* in unbalanced "V's," (C, fig. 18), was used on the way to and from the target because of its defensive possibilities and maneuverability. Although there is little indication that this exact formation was used widely, it may be assumed that on long missions either the line abreast or some similar, relatively undemanding formation was used on the flight to and from the target.

The number of aircraft employed varies with the size of target and type of mission. During the assault by the ground forces on the enemy main defense line, simultaneous assaults were made by three or more formations of from 28 to 36 aircraft each, followed by similar waves spaced from 30 minutes to 2 hours apart.

In the support of the main effort, the density of attack by ground attack aircraft often reached five or six formations of from 28 to 36 aircraft, attacking at 5- to 15-minute intervals. Operations in secondary zones were supported by small formations of from four to six aircraft concurrently with the mass attacks in the zone of main effort.

In defensive operations, steady pressure was maintained by formations of from 4 to 20 aircraft attacking at frequent intervals. Attacks on the enemy's forward area were carried out usually by

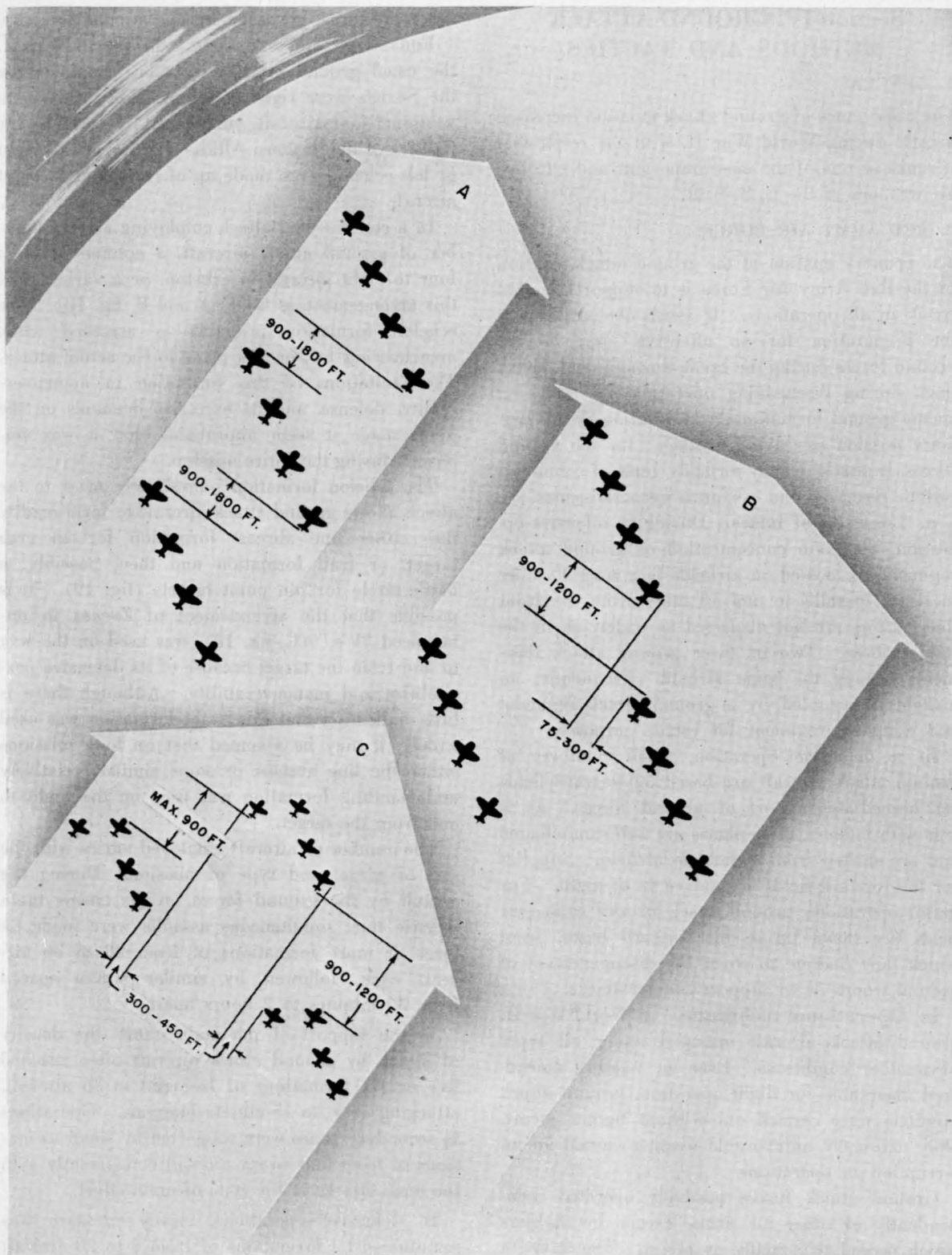


Figure 18.—Typical ground attack formations.

small formations of from 4 to 12 aircraft, normally striking beyond the range of friendly artillery. Enemy airfields were attacked by formations of from 16 to 32 aircraft, frequently followed by similar waves.

**TARGET APPROACH.** The Soviets advocate a low level approach for ground attack aircraft for greater protection against enemy fighters and to maintain the element of surprise. Low level flight is used particularly on free-lance missions against enemy fighters and to maintain the element of surprise. Low-level flight is used particularly on free-lance missions against ground targets with weak antiaircraft belts to attack roads and other special targets. However, in areas where intense antiaircraft fire was encountered, ground-attack aircraft frequently flew at altitudes ranging from 2,500 to 4,000 feet.

The direction of the approach usually was predetermined by previous reconnaissance. Full advantage was taken of sun, cloud cover, and terrain.

**ATTACK ON FRONT LINES.** In attacks on front-line targets, the time of arrival and time over target were prescribed strictly. Each wave of attacking aircraft covered its target in the time allotted, and then left to avoid interfering with the following wave.

For attacks on area targets, such as sectors of the front, the frontal run up is used, with each formation of from four to eight aircraft attacking in line abreast. Rockets are fired from 1,500 to 2,000 feet, in a 30- to 45-degree dive, followed almost immediately by release of bombs and fire from aircraft. When there is only one run on the target the entire bomb load is dropped. When several runs are made, bombs are dropped singly or in small salvos. In attacks on line or pin point targets the aircraft attack in trail with little interval or peel off from echelon formation into a battle circle (fig. 19). Aircraft guns are fired first and, if tracers show the aim to be accurate, the rockets are fired. Bombs are released after the rockets are fired.

Every wave of ground attack aircraft contains a formation whose primary mission is to neutralize enemy antiaircraft batteries. Usually, these aircraft remain behind the larger formation and wait until the enemy opens fire before launching the attack. If, however, the antiaircraft positions are known, the aircraft do not wait, but fly in ahead of the

main formation to attack the antiaircraft batteries. If the antiaircraft batteries are neutralized on the first attack, the aircraft join in the attack on the target. When there is no air opposition, escort fighters assist in attacks on antiaircraft positions.

**COORDINATION WITH ARTILLERY.** Operations by large ground attack formations on the enemy front line are combined and coordinated with the artillery preparation during the break-through of the enemy's defenses. During the artillery preparation, ground attack aircraft attack targets which the artillery cannot cover adequately. In addition, they deliver a mass attack on the enemy's second defense line to neutralize it and to deny the enemy opportunity to consolidate forces withdrawing from the first line. When the first defense line is taken, artillery fire is shifted to the second line while the ground attack formations attack the third. The result is a rolling barrage of artillery fire and bombing, strafing, and rocket attacks on the entire enemy defense system.

In addition to these mass attacks on enemy defense lines, ground attack formations continually attack all enemy troops and matériel in the forward area to disorganize the retreat of the enemy, to impede the movement of enemy reserves, and to liquidate small pockets of enemy resistance.

**COOPERATION WITH TANKS AND OTHER GROUND FORCES.** Ground attack units also are attached to tank units effecting a deep penetration. When opposition is particularly heavy, ground attack aircraft fly continually above the tanks to attack enemy pockets of resistance which might impede tank movement. The flanks, in particular, are reconnoitered to prevent a surprise attack from these directions. When opposition is light, small numbers of ground attack aircraft normally escort tank units. The others remain in readiness on their airfields. They attack pockets of enemy resistance impeding the tank advance upon call from the tank spearhead commander. When the mission is completed, the aircraft return to base. Cooperation with infantry, motorized units, and other ground forces is generally similar.

**ATTACKS ON TRAINS.** To attack moving trains, aircraft approach from the front at an angle of from 15 to 20 degrees to the direction in which the train is going. Aircraft attack in pairs, one plane diving to the attack while the other provides cover and returns antiaircraft fire from the train.

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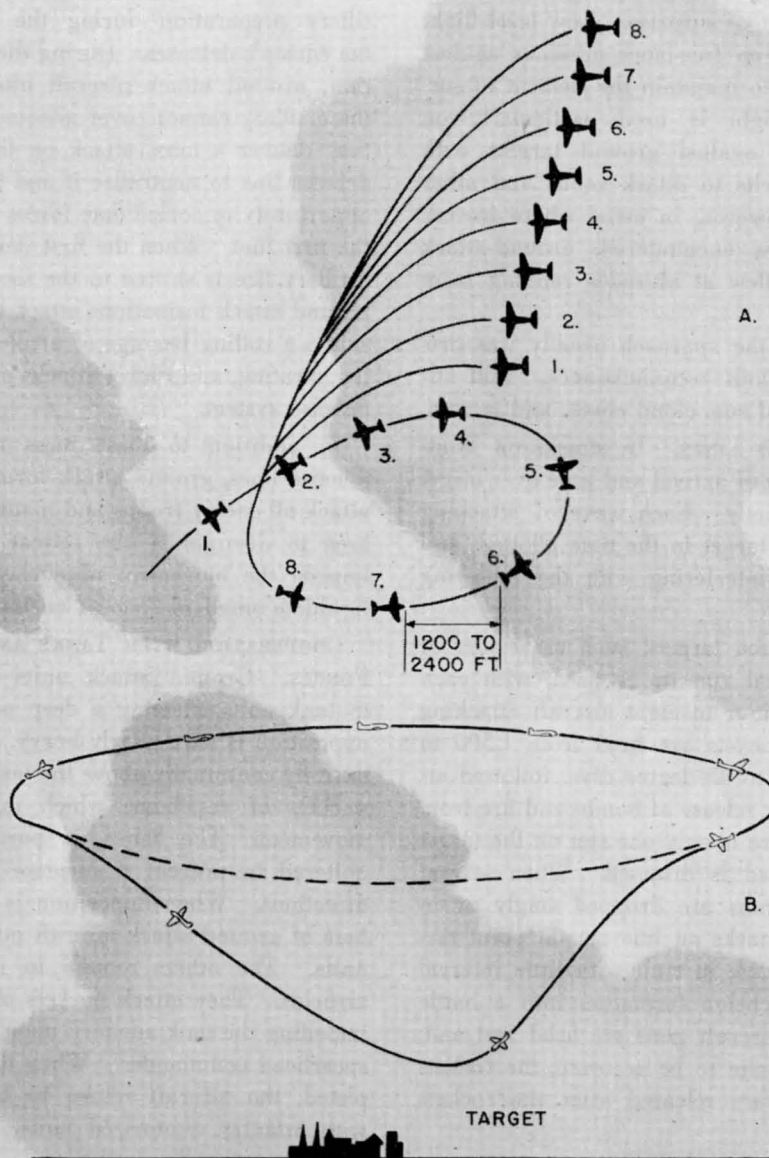


Figure 19.—The battle circle.

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Trains are attacked preferably in mountain passes or valleys to block traffic. Rail junctions and switch installations also are targets, and the attack is regarded as effective if trains are delayed for 5 hours or more.

To attack stationary trains, ground attack aircraft fly the "snake" pattern (fig. 20). The ground attack aircraft, in a distended echelon right or left formation, approach the target at an angle of from 5 to 10 degrees. Attack is delivered by single aircraft diving at the target and then making a small climbing turn to repeat the attack from the opposite end. Locomotives are attacked with rockets and aircraft guns. Bombs are dropped on railroad cars.

**ATTACKS ON AIRFIELDS.** Attacks on airfields usually are made by from 12 to 16 aircraft. The approach flight is made at low level only when antiaircraft positions and other ground defenses are well known. Even when low level flight is employed, the aircraft climb to an altitude of from 2,000 to 2,500 feet while 2 miles from the target to deliver the attack. In night and dawn attacks, ground attack aircraft endeavor to make a noiseless approach by gliding toward the target until antiaircraft fire is received. A specific target is assigned to each of the three to four attacking formations, four aircraft each. One formation attacks the antiaircraft artillery. Another formation prevents the aircraft on the field from taking off. The remaining one to two formations attack the parked planes. All attacking aircraft use rockets, bombs, and aircraft guns in the attack.

**RECONNAISSANCE.** Ground attack regiments also are called upon frequently to fly reconnaissance missions, weather reconnaissance included. Reconnaissance missions usually are flown by from four to six aircraft, without fighter escort. Ground attack aircraft always bomb and strafe the reconnaissance target.

**DEFENSIVE MEASURES.** Ground attack aircraft usually are provided fighter escort. (For defensive formation with fighter escort, see Fighter Methods and Tactics.) When enemy fighters are detected early enough, ground attack aircraft employ the "S" or "snake" pattern to withdraw to friendly lines, particularly to zones of friendly antiaircraft fire.

Evasive action against enemy antiaircraft fire consists of increasing the distance between indi-

vidual aircraft and also between formations. Altitudes of formations also are changed continually during flight, and zones of antiaircraft fire and strong defensive areas are avoided when possible.

### 3. RED NAVAL AIR FORCE

During the first 2 years of World War II, the main mission of naval ground attack aircraft was to assist the Red Army Air Force in supporting ground operations. After this period, they were used chiefly against enemy convoys and harbor installations.

The tactics and formations employed by ground attack aviation of the Red Naval Air Force did not differ materially from those of the Red Army Air Force.

**a. Attacks on convoys.** Attacks on convoys are carried out by two types of formations. Ground attack aircraft, alone, or ground attack aircraft and bombers may be used. Even when both ground attack aircraft and bombers are used, the ground attack aircraft fly to the target independently with their escort, timing their arrival to coordinate the attack with the bombers assigned the same target.

**STRENGTH AND FORMATIONS.** When only ground attack aircraft are employed to attack a convoy, the formations vary from 12 aircraft to 2 regiments (60 aircraft), depending upon the size of the convoy, its importance and its fighter and antiaircraft defenses. Formations employed are the same as those of the Red Army Air Force, the smaller formations of from six to eight aircraft flying from 650 to 1,300 feet apart at right or left echelon in column or line. When two regiments participate in the attack, each regiment flies in the same manner, with one regiment from 150 to 700 feet above and from 2,000 to 2,500 feet away from the other.

In a combined attack with bombers, the number of ground attack aircraft rarely exceeds one regiment (32 aircraft).

**EXECUTION OF ATTACK.** The ground attack formation usually approaches a convoy at an altitude of from 2,000 to 3,000 feet. Sun and cloud cover are utilized for concealment. As with Red Army Air Force ground attack formations, certain formations are assigned the mission of neutralizing antiaircraft defenses. When the antiaircraft defenses are too strong to be neutralized successfully, or when there is strong fighter defense, the target is

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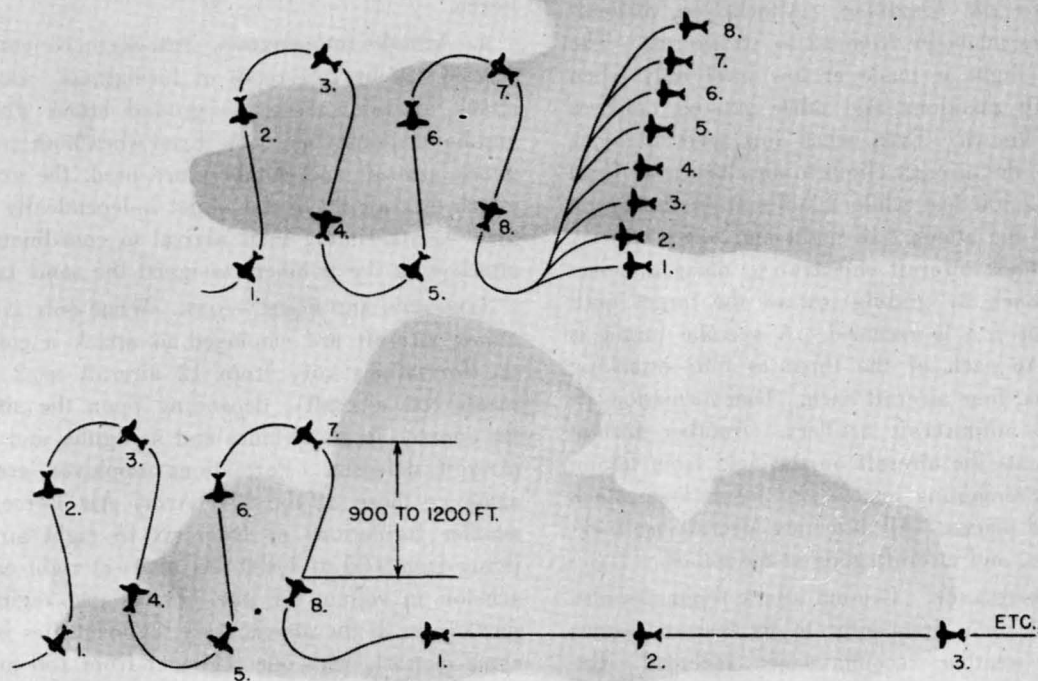


Figure 20.—The "snake" pattern.

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attacked in one run by the entire formation. Bombs are dropped by the entire formation immediately after the formation leader drops his. When it is possible to neutralize the antiaircraft defenses and contain the enemy fighters, the subordinate formations of from six to eight aircraft are dispersed according to a prearranged plan. The first approach is made by the subordinate formations attacking successively in line abreast from different directions. The order in which subordinate formations attack is determined by the formation leader. Approaches are made next by individual aircraft attacking definite targets assigned them by the formation leader. Bombs are dropped singly from 1,200 to 2,500 feet, and bombing attacks are followed by low-level strafing.

In addition, several aircraft of the ground attack formation are assigned to bomb from mast height. The aircraft employed for this type of mission fly slightly in the rear of the ground attack formation while approaching the target. When at the proper range for attack, these planes dive sharply towards the target, level out at mast height, and drop their bombs at right angles to the length of the ship. Timing of these attacks is controlled by the formation leader. Usually, they follow the main bombing attack.

In the combined attack on convoys with bombers, ground attack formations are given a definite time attack. The method of attack does not vary from that of exclusively ground attack operations against convoys. As previously mentioned, the ground attack aircraft operate independently from the bombers. Upon completion of their attack, they make way for the bombers.

**b. Attacks on harbors.** Attacks on harbors are carried out by large mixed formations with all types of ground attack, bombers, torpedo, and fighter aircraft participating.

**EXECUTION OF ATTACK.** In attacks on harbors by large mixed formations, at least one ground attack regiment, and occasionally as many as two to three regiments, are used. Attacks are carried on a rigid timetable. Bombers attack the harbor installations. Torpedo aircraft attack shipping in the harbor. The ground attack formations attack the antiaircraft defenses. Escorting fighters protect the formations to which assigned. Other fighter formations blockade enemy airfields or intercept enemy fighters.

Each individual formation reaches the target at a different time and altitude and, except for the necessary coordination according to the timetable, completes its mission independently of the other formations. The usual procedure is for the ground attack formation to arrive before the bombers. After the first wave of bombers attack, some of the ground attack aircraft attack antiaircraft batteries on ships in the harbor to facilitate the approach of torpedo aircraft.

Following the torpedo attack, the ground attack aircraft usually are relieved over the target by other ground attack formations, which renew the attack on antiaircraft and other shore installations for the second wave of bombers and torpedo aircraft. Frequently, a third formation of ground attack aircraft arrives immediately after the departure of the second wave of bombers and torpedo aircraft to bomb and strafe any remaining targets.

## **Section V. SHORT RANGE BOMBER METHODS AND TACTICS**

### **1. GENERAL**

From the very beginning of World War II, the short range bomber force appears to have been neglected, particularly as to production, in favor of the fighter and ground attack forces. In contrast to the fighter and ground attack forces, the short range bomber force did not procure a sufficient number of planes until the war was drawing to a close, at which time there was a surplus of bombers. The short range bomber force did, however, have sufficient personnel. But, it was deficient in crew training. The lack of precision instruments for bombing and navigation, which were used as a matter of course by the Western Allies, had a particularly bad effect.

Toward the end of World War II, the Soviets tried to rectify their neglect of the short-range bomber force. This already was in evidence in the development of bombers and radar, bombing, and navigation equipment. However, these developments were not introduced generally before the end of hostilities. What effect these new or future developments will have on the methods and tactics of the short range bomber force is not known at present.

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## 2. RED ARMY AIR FORCE SHORT RANGE BOMBERS

In World War II, short range bombers were employed almost exclusively for tactical bombing in support of ground operations. The principal missions assigned to short range bombers included destruction of enemy troops and matériel on the battle field, on the march, and in assembly areas; destruction of supply and communication lines; destruction of rail and other transport; destruction of enemy fuel, ammunition, and supply dumps; destruction of enemy airfields and installations and equipment thereon; and reconnaissance.

**a. Location of bases.** For an offensive operation short range bomber units are based in the same general area as ground attack aircraft. As are ground attack aircraft, two or three short range bomber regiments are based on the same field. Their fighter escort frequently is based with them.

In a defensive operation short range bombers are based on airfields from 100 to 150 miles from the front.

**b. Operational technique.** Bombing missions were carried out almost exclusively by day up to the end of World War II. Individual elite crews were sent out on night missions, in special emergencies, but these missions were rare. Weather also restricted daylight operations. Operations were not flown in an overcast because the short range bomber force was not adequately equipped with blind flying instruments.

**FORMATIONS AND STRENGTH.** Formation is flown in groups of nine aircraft of three flights of three aircraft each. Each flight and each group are arranged in "V" formation. The groups fly one behind the other at staggered altitudes. A loose formation is flown to the target. However, upon reaching the target area, the formation is closed up as closely as possible.

The strength employed varies with the importance and type of mission. Operations are carried out frequently by divisions, with each regiment supplying from two to three groups of aircraft.

**BOMBING TECHNIQUE.** Although a few regiments specialize in dive bombing, level flight bombardment is more common. Flights lose from 500 to 600 feet on the bomb run, with the result that bombs are dropped from a slight glide rather than from strictly level flight. Bombs are dropped usually by each flight of aircraft, with the wingmen

releasing theirs immediately after the flight leader drops his.

The angle of dive never exceeds 60 degrees for the TU-2 in dive bombing. However, the PE-2 has better diving qualities and frequently dives at greater angles.

Occasionally a combination of both types of attack is employed, with a few aircraft attacking antiaircraft positions in a dive while the main body of bombers attack the target in level flight. Blind bombing is rare because of the lack of suitable equipment. On these rare occasions, the target is approached from a visible landmark and the bombs are dropped on an estimated time of arrival over target. This method is inadequate for precision bombing, and can be used only against large area targets.

Bombing altitudes always are specified in orders and vary according to the location of the targets. Targets in the enemy forward area are bombed from altitudes of from 2,500 to 6,000 feet. Those in the enemy rear areas are bombed from higher altitudes, ranging from 10,000 to 16,000 feet. For reasons of safety, the tendency prevailed during World War II to bomb from as high an altitude as possible. Lower altitudes were used only when necessitated by cloud cover.

**DEFENSIVE MEASURES.** Fighter escort is provided for short range bomber formations. For additional protection, routes are chosen carefully. Heavily defended areas are avoided whenever possible. Courses are changed frequently and the target approach is made to take full advantage of the sun and existing cloud cover. Evasive action against flak consists of variations in altitude and course. Evasive turns normally are limited to from 15 to 20 degrees.

**c. Reconnaissance.** Short range bombers usually carry out reconnaissance missions for their own benefit to locate suitable targets in absence of orders from higher headquarters, to determine the exact location of a specified target, to watch possible river crossing points for signs of enemy activity, or to determine exact weather conditions. The radius of action varies and depends upon the type of aircraft with which the particular regiment is equipped. Aircraft are sent out singly. When two are assigned to the same mission, there is an interval between their take offs, and each aircraft flies its mission independently. Altitudes range up

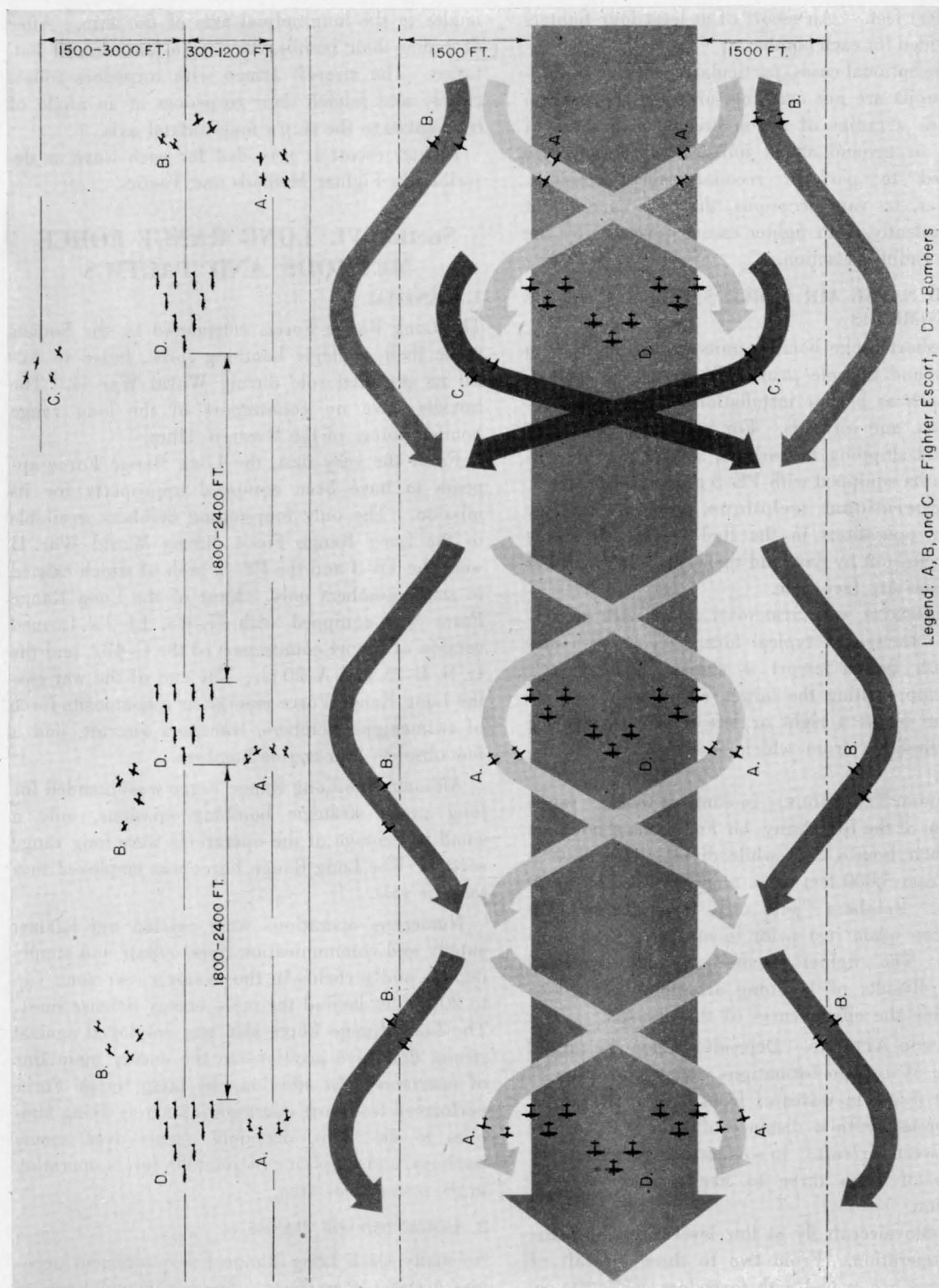


Figure 21.—Typical bomber formation with fighter escort.

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to 16,000 feet. An escort of at least four fighters is provided for each bomber.

In exceptional cases, particularly when reconnaissance units are not available or when the mission demands a radius of action greater than those of fighter or ground attack units, bomber units are required to perform reconnaissance missions. However, on rare occasions, they are carried out independently, with fighter escort governed by the fighter radius of action.

### 3. RED NAVAL AIR FORCE SHORT RANGE BOMBERS

Naval short range bomber units are equipped with PE-2's and operate principally against fixed targets, such as harbor installations, coastal artillery positions, and airfields. For attacks against convoys and shipping in harbors, special torpedo aircraft units equipped with PE-3 aircraft are used.

**a. Operational technique.** Short range bomber operations in the Red Naval Air Force are carried out by day, and then only when weather conditions are favorable.

**FORMATIONS AND STRENGTH.** Strength of formations varies. A typical formation of 27 bombers with fighter escort is shown in figure 21. Upon approaching the target, each group of nine bombers forms a right or left echelon depending upon direction from which attack was to be delivered.

**BOMBING TECHNIQUE.** In contrast to short range bombers of the Red Army Air Force, navy bombers drop their bombs only while diving. The dive is made from 5,000 feet at an angle of from 60 to 70 degrees. Bombers "peel off" from the echelon formation taken just prior to attack to drop their bombs. The fighter escort provides overhead cover. Results of bombing are photographed to determine the effectiveness of the attack.

**TORPEDO ATTACKS.** Depending upon the target, the size of torpedo formations varies from 6 to 27 aircraft flying in waves of from 3 to 9 aircraft in line abreast, with a distance of from 150 to 300 feet between aircraft. In some instances, each wave consists of from three to five aircraft in "V" formation.

Torpedo aircraft fly at low level throughout the entire operation. From two to three aircraft of each wave are armed with torpedoes, while the remainder carry bombs. The aircraft carrying bombs attack first, from low level and at right

angles to the longitudinal axis of the ship. After dropping their bombs, they strafe anti-aircraft batteries. The aircraft armed with torpedoes follow closely and launch their torpedoes at an angle of 60 degrees to the ship's longitudinal axis.

Fighter escort is provided for each wave as described in Fighter Methods and Tactics.

## Section VI. LONG RANGE FORCE METHODS AND TACTICS

### 1. GENERAL

The Long Range Force, considered by the Soviets to be their strategic bombing force, failed to fulfill its intended role during World War II. The Soviets have no counterpart of the long range bomber forces of the Western Allies.

From the very first, the Long Range Force appears to have been equipped improperly for its mission. The only four-engine bombers available to the Long Range Force during World War II were the TB-3 and the PE-8, both of which existed in small numbers only. Most of the Long Range Force was equipped with IL-4's, LI-2's (armed version of Soviet counterpart of the C-47), and the U. S. B-25 and A-20 G. The end of the war saw the Long Range Force emerge as a composite force of twin-engine bombers, transport aircraft, and a few obsolete four-engine bombers.

Although the Long Range Force was intended for long range strategic bombing missions, only a small percentage of the operations were long range sorties. The Long Range Force was employed in a tactical role.

Numerous operations were carried out against supply and communication lines, repair and supply depots, and airfields in the enemy's rear zone (up to 200 miles behind the main enemy defense line). The Long Range Force also was employed against strong defensive positions in the enemy main line of resistance. In addition, the Long Range Force performed transport operations, such as flying supplies to the front, dropping agents over enemy territory, and supplying of guerrilla forces operating in the enemy rear area.

### 2. LOCATION OF BASES

Normally, each Long Range Force regiment occupies a static home base. The regimental bases of each division are grouped together to facilitate liaison. During World War II, however, units were

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moved frequently, particularly when providing direct support for the ground forces, to temporary bases from 100 to 120 miles from the front line.

### 3. CONTROL

Commitment of the Long Range Force is directed by the General Headquarters, through which all requests must pass. The commander of the Red Army Air Force is a member of the General Headquarters, and, thus, has considerable influence in the operational control. Administratively, however, the Long Range Force became a part of the Red Army Air Force in December 1944.

### 4. OPERATIONAL TECHNIQUE

The procedure for tactical and strategic operations is believed to be the same. The majority of the missions are carried out at night. However, it is believed that day missions also are undertaken, although their extent and procedure are not known.

**a. Formations and Strength.** On night missions, the Long Range Force used no special type of formation. The conventional bomber stream was formed automatically by the lapse of time between each aircraft taking off. Differences in speed of take off lengthened or shortened the bomber stream, which caused, among other difficulties, dispersion of effort. Efforts were made in 1944 to improve the situation, and aircraft were required to proceed to a general assembly area and then to fly in formation to the target. The number of aircraft employed varies with the target to be attacked. As many as 200 bombers have been employed on certain missions.

**b. Procedure.** Operational orders usually are received several hours in advance so that crews can be briefed. Take-off time varies according to the time of the year, to allow crossing of the front lines as soon as possible after dark.

At one time, the approach altitude was prescribed. However, this practice is believed to have been abandoned. The height of attack always was stipulated, and any infringement of this order was a punishable offense.

The height of attack varies according to the target to be attacked, anticipated antiaircraft defense, and the type of aircraft employed. Normally it is from 10,000 to 16,500 feet for targets in the enemy interior, and from 1,600 to 6,600 feet for objectives in the combat zone.

The attack on the target is made either by all aircraft from an exactly prescribed direction and height, or in a concentric form at different heights and from several directions. Bombs are dropped on the first run, a second run being exceptional.

After dropping its bombs each aircraft flies to a predetermined departure point and from there returns on a prescribed course to its home base. At least one alternate airfield is designated. Oral and written reports are made by each crew immediately after landing.

Although during World War II target marking had not been introduced generally, attempts were made to mark specific objectives by dropping flare cascades. Two or three aircraft of each regiment participating in the attack carried flares for this purpose. Different colored flares were used to confirm a correct cascade setting or to warn attacking aircraft that the cascade had been placed incorrectly.

**c. Fighter escort and patrol regiments.** No direct fighter escort was provided for bombers of the Long Range Force operating at night. In the spring of 1944, the Soviets introduced patrol regiments equipped with a night-fighter version of the U. S. A-20 G. They provide indirect protection for the Long Range units by attacking searchlights, antiaircraft batteries, and airfields in and around the target area. In addition, patrol regiments frequently attack railroads and roads to block and prevent dispersal of transport in the target area. For this type of mission, the A-20 G was armed with four 20-mm. cannon, four 12.7-mm. machine guns, and four rockets.

## Section VII. RECONNAISSANCE METHODS AND TACTICS

### 1. GENERAL

During World War II, the Red Army Air Force emphasized reconnaissance. Specialized reconnaissance units included long range reconnaissance regiments, reconnaissance regiments of the air armies, and reconnaissance-spotting regiments under army group control. According to official Soviet data reconnaissance-spotting aviation, alone, increased 1,800 percent from January 1942 to January 1945. In addition to these specialized units all fighter, ground attack, short range bomber, and Long Range Force units performed reconnaissance missions.

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The basic technique of reconnaissance in the Red Army Air Force is aerial photography supplemented by visual reconnaissance. From 50 to 70 percent of all reconnaissance missions performed by Soviet fighter aircraft in World War II were photographic missions. All ground attack aircraft employed on reconnaissance missions were equipped with cameras and few, if any, missions were flown for visual reconnaissance exclusively. Visual reconnaissance, supplementing aerial photography, is essential on all aerial reconnaissance missions. During defensive operations and for the adjustment of artillery fire visual reconnaissance alone often is used by the Soviets.

## 2. TACTICAL RECONNAISSANCE

Tactical reconnaissance is employed in direct support of ground forces and normally is limited to friendly assembly areas, the enemy main line of defense, and its immediate approaches. These general limits may be extended for tank and river-crossing operations.

**a. Units.** During World War II, tactical reconnaissance was flown primarily by reconnaissance-spotting regiments under army group control, and less commonly by reconnaissance regiments of the air armies. Frequently, fighter and ground attack units flew tactical reconnaissance in addition to their other missions.

**b. Control.** All units engaged in tactical reconnaissance are under the technical and administrative jurisdiction of the air army of each army group. Operationally, however, units employed for photo reconnaissance are attached to ground armies or more specifically to army artillery commanders, tank commanders, and, if a river crossing is to be undertaken, engineer commanders. Reconnaissance-spotting regiments, or other units used to adjust artillery fire, are attached to or support artillery divisions, and, sometimes, even brigades or regiments.

**c. Procedure.** Outstanding emphasis is placed on comprehensive briefing of air personnel and on limitation of aerial reconnaissance areas which cannot be observed from the ground. Prior to a mission, air personnel study all pertinent ground observation and intelligence documents, particularly photo panoramas, combined sketches of blind areas, and army intelligence maps. Air personnel also visit key ground observation posts to study the situation whenever practicable.

**d. Photo reconnaissance.** Requests for tactical reconnaissance normally originate with the commanders of the ground arms, especially artillery, and are coordinated by the army intelligence officer. For normal operations, requests are for verticals of approximately 1:15,000 scale, or sometimes larger scales for limited areas and pin-point targets. These verticals are gridded by the Topographic Service with the standard Soviet 1,000-meter grid. They are used as the basic map substitutes by all arms.

**e. Adjustment of artillery fire.** Artillery fire is adjusted from the light two-seater U-2, the slow but heavily armored IL-2, fighter, or from an observation balloon. The artillery battalion is the smallest unit for which air adjustment of fire is provided. Aerial observation is limited normally to ranges in excess of 5,500 yards or to areas which cannot be observed from the ground. Thorough briefing of the pilot and the observer on landmarks, orientation points, and recognition signals is required to reduce time in the air and to obviate errors.

Two methods are used by the Soviets to initiate the adjustment of fire. The first, and more common method, is the firing of battery or battalion ladders, a series of salvos fired at successive ranges on the same azimuth. In the second method, a flare or smoke bomb is dropped from the plane at a point visible to ground observers, and the air observer senses the flare or bomb. Ground observers combine the location of the flare or bomb and the air observer's sensing to compute initial data. The air observer then conducts fire in the normal manner.

## 3. OPERATIONAL RECONNAISSANCE

Operational reconnaissance covers areas up to 200 miles behind the enemy's front lines and has the primary mission of supporting the operations of army groups and their principal components, both ground and air. It embraces all coverage required for major offensive or defensive operations of the army group and for the fire plans of supporting artillery and air forces.

**a. Units.** Operational reconnaissance is carried out mainly by reconnaissance regiments of the air armies. When necessary, long-range reconnaissance units may be employed. Frequently, during World War II, bomber units flew operational reconnaissance in addition to their other missions.

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**b. Control.** Control of reconnaissance regiments engaged in operational reconnaissance is the responsibility solely of the air army commander. Army group headquarters requests operational reconnaissance from the air army commander, who must meet the over-all requirements of the army group.

**c. Procedure.** Requests for operational reconnaissance missions originate with infantry, tank, artillery, or engineer commanders. They are forwarded to army group headquarters, where they are coordinated by the army group intelligence officer and forwarded to the air army commander. The air army commander then assigns missions to reconnaissance units or to any other units he deems necessary.

**SUPPORT OF OFFENSIVE OPERATIONS.** The principal mission of operational reconnaissance in the support of any offensive operation is the taking of aerial photographs for the correction of existing maps. From 160 to 180 square miles may be photographed for each rifle corps. The usual scale of photographs taken is from 1:17,000 to 1:20,000. On the first photo run for over-all coverage of the enemy defensive zone, photographs with a scale of from 1:10,000 and 1:8,000 are taken. On successive runs over important sectors, the scale is increased to from 1:6,000 to 1:3,000. The number of runs made depends upon the area covered and its importance. For an attack on a fortified position, at least three runs are mandatory.

Photo reconnaissance missions over the assembly area of friendly troops are flown to check the condition of all roads so that full utilization of the existing road net may be made. In the area of the line of departure, photo reconnaissance is flown to determine the areas invisible to the enemy, commanding heights, degree of cover from enemy aerial reconnaissance, and covered approaches. In the enemy defense zone, photo reconnaissance is carried out to locate areas invisible to friendly ground troops, enemy observation posts (particularly those which might be used by advancing friendly troops), tank obstacles, possible landing fields, roads, and passes. Photo reconnaissance of the enemy rear area is of assistance in developing a plan for pursuit of enemy forces should the offensive be successful. Great emphasis is placed on locating roads and, particularly, sectors where road blocks or other barriers might exist.

In addition to the basic mission of providing information for the correction of existing maps, photo missions are flown to provide special photomaps for tank units. These photomaps include enemy position areas, tank obstacles, orientation points, and areas not suited to tanks. For river crossings, special photo missions are flown and photomaps of 1:10,000 scale are prepared of the approaches to both sides. Stereo pairs are indispensable and special attention is paid to shores, wooded areas, and roads.

**SUPPORT OF DEFENSIVE OPERATIONS.** Both photo reconnaissance and visual reconnaissance are employed in the support of a defensive operation. Priorities are placed on photographing of the friendly forward area and outpost line of resistance, and on visual reconnaissance of the rest of the zone of operations. Key reconnaissance objectives are natural obstacles, the condition of friendly and enemy roads and approaches, and observation posts available to the enemy. The main mission of this reconnaissance is to correct existing maps of 1:50,000 scale. The average area covered is from 100 to 120 square miles for each rifle corps. In addition, a limited number of missions are executed to provide 1:10,000 and 1:15,000 photo maps of key defensive sectors and to check friendly camouflage.

**d. Technique of aerial reconnaissance.** Orders for tactical or operational aerial reconnaissance are transmitted to the regiments concerned the night before an operation whenever practicable. This allows time for the regimental commander to plan the number of sorties, take-off schedules, mission of each individual flight, and to arrange for fighter escort.

**BRIEFING OF CREWS.** The squadron Commander briefs the crews. The *Sturman* also is briefed in detail by the squadron *Sturman*, and the radio operators by the squadron signal officer. When the situation permits, flight crews are oriented on the front lines by the combat troops concerned.

For the briefing of crews engaged on operational reconnaissance, standard Soviet operational maps, 1:200,000 particularly and 1:500,000 less commonly, are used. For tactical reconnaissance, 1:100,000 and 1:50,000 maps are widely used and 1:50,000 and 1:25,000 maps and 1:20,000 mosaics are used occasionally.

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The line of battle, enemy airfields, and anti-aircraft defenses are marked on the maps. The crews are supplied also with accurate information concerning changes in the enemy position. It is forbidden to make entries on the maps concerning Soviet positions, airfields, navigational aids, or unauthorized notes. For a pin-point photo reconnaissance mission, the *Sturman* is given a prepared section of a map with the objectives marked on it.

**EXECUTION OF MISSION.** The first reconnaissance aircraft takes off during the early morning hours and flies weather reconnaissance in addition to its other reconnaissance missions. The crews which take off later also forward weather reports if necessary, giving information concerning visibility, cloud cover, cloud base and ceiling, heights of clouds, and direction of cloud movement. Icing and direction and strength of wind allegedly are not reported.

Sorties are flown from dawn to dusk, with emphasis on the morning hours. Take-off times are changed daily as a counterintelligence measure. The crews select the route, never a straight line, and the altitudes at which the mission is to be flown. The front line is crossed at weakly defended points. Crossing points vary from day to day.

When there is little or no cloud cover, reconnaissance aircraft fly at 23,000 feet over enemy territory. Reconnaissance objectives behind the front lines are photographed from this altitude, and at such lower altitudes as are needed. Fortified positions along the front line are photographed from 10,000 feet or lower. The minimum altitude for aerial photography is 4,000 feet. Below 4,000 feet, all reconnaissance is visual. When enemy anti-aircraft fire is weak, one aircraft will photograph two or three strips. When strong enemy defensive fire is expected, several aircraft are sent out in succession, or the same crew makes several flights, photographing one strip each time. Withdrawal always is flown over a different route. Visual

reconnaissance is continued during the withdrawal.

**FIGHTER ESCORT.** There is a general order that fighter escort must be provided when the altitude for reconnaissance aircraft is less than 16,000 feet. In actual operations, the IL-2 reconnaissance aircraft usually fly without escort, unless the mission is especially important. Bomber aircraft, such as the PE-2, are provided with fighter escort of from four to six fighters, and more in special cases, when taking area photographs over the line of battle or directly behind it. The reconnaissance aircraft usually fly over the fighter airfield, where they are joined by the escorting fighters. Sometimes, if the fighter field is large enough, reconnaissance aircraft land on the fighter base and take off with the escort.

**COMMUNICATION.** Reconnaissance aircraft remain in constant contact with their own regiment and with units for which the reconnaissance is being conducted. Visual reconnaissance data is transmitted by voice in the clear, except for coded reference points. Weather reports are transmitted in code until the reconnaissance aircraft reach the front line. While over enemy territory, only important messages are transmitted. A short summary of reconnaissance results is transmitted when the reconnaissance aircraft cross the enemy front line on the return flight.

**DAILY OPERATIONS REPORT.** A full report is made by the crew upon landing. Important reconnaissance information is telephoned immediately to the headquarters concerned by the regimental intelligence officer. If exact details of especially important reconnaissance information is necessary, the *Sturman* of the crew are flown to air army or army group headquarters to make a personal report. At the end of each day of operations, the regimental operations officer assembles a daily reconnaissance report, which is sent to air army headquarters along with all air reports and interpretations of all photographs taken.

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## **PART III. TRAINING AND REPLACEMENT**

### **Section I. GENERAL**

Training in the air forces of the U. S. S. R. is basically similar to the programs of the Western air forces. Students pass from one level of training to another through well-organized, and often highly specialized, schools. During World War II, the Soviet policy of "flexibility" permitted many emergency changes within this basic structure.

#### **1. SEPARATE TRAINING PROGRAMS**

The army, navy, and the Civil Air Fleet have separate air-training programs. The Long Range Force maintained special schools to supplement the standard Red Army Air Force training, and some of the Long Range Force flying personnel received their entire training in such schools. Although the Long Range Force is now an air army and no longer an independent arm, it is probable that its training system still exists. In addition, the Red Army Air Force has a few small, highly specialized schools, several for the training of command officers and one for the formation of elite regiments.

#### **2. PREMILITARY TRAINING**

A unique factor in Red Army Air Force training is the extensive premilitary training of civilians. During the decade preceding World War II, aviation clubs were giving both theoretical and practical training to thousands of Soviet youths. By drawing from this large pool of partially trained airmen, the Red Army Air Force simplified its wartime training problems.

#### **3. SCOPE OF TRAINING**

The doctrine that the Red Air Force is mainly an aid to the Red Army has affected the type of flying a pilot must be trained to perform. With ground attack operations and fighter patrols constituting a majority of the sorties, the Red Army Air Force can dispense with much training that is essential to a strategic force.

The usual Soviet mission is short and the formations participating are relatively small. Modern bomb sights, communications equipment, and navigation aids are not in widespread use. Therefore, navigation training can be limited, for the most

part, to dead reckoning and contact flying. Mass formation and precision bombing techniques can be neglected. These factors permit earlier specialization. Consequently, a Soviet flyer can be sent into combat with few flying hours.

### **Section II. RED ARMY AIR FORCE TRAINING**

#### **1. GENERAL**

The Main Administration of Replacement and Training is part of the Main Administration of the Red Army Air Force. The Main Administration of Replacement and Training is subdivided into the Administration for Organization of Unit Formation and Training and the Administration of Schools. The Administration for Organization of Unit Formation and Training is responsible for the formation of regiments and for the training of all Red Army Air Force personnel after they have entered replacement flight regiments. The Administration of Schools is responsible for all training below the level of replacement flight regiments, including elementary flying schools, service schools, *Sturman* schools, and air force specialist schools.

The academies of the Red Army Air Force are under the Administration of Air Academies, part of the Main Administration of the Red Army Air Force. The Administration of Air Academies is on the same level as the Main Administration of Replacement and Training.

To receive specialist ratings, personnel of the Red Army Air Force must graduate from one of the following programs: ground crew, radio operation, an air force specialist school for aerial gunners, *Sturman* school. Pilots must pass through both elementary flying schools and service schools to obtain ratings.

In pilot schools, the flexibility of Red Army Air Force training is especially pronounced. A pilot trainee's progress through the various stages of training is governed by demonstrated proficiency, rather than by the completion of a fixed number of flying hours as in the Western air forces. Consequently, all flying schools after the elementary

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schools vary markedly in size and can have no fixed monthly quotas.

The first stage of postgraduate training is the replacement flight regiment. Newly graduated personnel from the various schools are assembled and trained in newly activated units. These units are sent intact to the front, or are disbanded and the personnel sent to operational units as replacements.

Trainees washed out of pilot training usually are sent to a *Sturman* school or to an air force specialist school for different air training. If this, in turn, proves unsatisfactory, the trainee is sent to a specialist school for ground crew training.

## 2. PILOT TRAINING AND REPLACEMENT

**a. Elementary flying schools.** Pilot trainees for all branches of the Red Army Air Force, including the Long Range Force, receive their first formal air training in elementary flying schools. These schools are equivalent to USAAF preflight and primary schools. In addition to elementary flying, a certain amount of basic theoretical instruction is given. The courses include practical maintenance, aerodynamics, navigation, political instruction, and general military training. The entire course at these schools usually lasts from 7 to 9 months. The first 4 months are devoted entirely to theoretical preflight instruction.

Flying training includes a minimum of from 30 to 50 hours, usually in UT-2's or similar aircraft. During this period, trainees are classified for future specialization.

Although the number of flying hours a student receives in an elementary flying school appears inadequate, there are other important considerations. Flying time is utilized to the utmost. In order to avoid explanations and delays during actual flight, the trainee takes a written examination on the exercise to be performed prior to take-off. Because the usual training flight averages from 10 to 15 minutes, a student executes a great many landings and take-offs during his course. Because of this intensive practice in basic flying, a trainee is able to solo a combat type aircraft after few flying hours.

**b. Service schools.** When students finish elementary flying school, they enter service schools to begin specialization. The level of training in these schools is similar to that of the USAAF advanced flying schools. Actually, it goes beyond USAAF advanced schools in that a large part of training in these schools is given in operational type aircraft.

There are three types of service schools, fighter, ground attack, and bomber. Each school trains students solely for one category of aircraft, with the exception of some fighter service schools which have one ground attack squadron to which students disqualified during fighter training are transferred.

Ground schools present training in signal communications, tactics, topography, meteorology, bombing, aerial gunnery, and radio navigation. Elementary flying school subjects also are continued.

Flying training in service schools includes approximately 70 hours, half of which are spent in operational aircraft. Approximately 10 hours are devoted to instrument flying. There is a limited amount of formation flying and aerial gunnery. Upon graduation, the student is a rated pilot eligible for a commission. Although he has considerable experience in first-line aircraft, he has had no real combat training.

**c. Replacement air regiments.** All ground and air crew personnel in the Red Army Air Force go to replacement air regiments after graduation from schools. Here, crews and units are formed and complete units are activated. All personnel receive from 6 to 10 weeks of intensive combat training.

During World War II, badly depleted units were reformed and reoutfitted in replacement air regiments. Individual replacements also are drawn from replacement air regiments. The replacement air regiments provide formal combat training and are similar to USAAF operational and replacement training units.

Most theoretical training is completed at this stage, unless a trainee fails to pass the ground school comprehensive examination. Actual flying usually includes from 20 to 30 hours of bombing, gunnery, formations, instruments, and simulated battle techniques. All replacement air regiment training is divided, as is service school training, into either fighter, ground attack, or bomber training.

A wartime function of the replacement air regiments that possibly may be discontinued is the storage of aircraft. Almost all the replacement regiments were based near aircraft factories and provided a reserve supply of first-line aircraft.

**d. Demonstration and training regiments.** Demonstration and training regiments were an emergency wartime measure to save time and to

help relieve the replacement air regiments. They acted as field replacement regiments for the air armies and were responsible for the rapid reout-fitting and training of depleted front-line units. It is believed that they have been discontinued.

**e. Advanced pilot training.** Special schools for pilots and *Sturman*, called flying training establishments, give further specialized instruction to a limited number of carefully selected pilots. Although some exceptional students are accepted directly from service schools, the majority of trainees are chosen from operational units. The course includes approximately 100 hours of actual flying, and there is extensive practical and theoretical training. The graduates are considered qualified for assignment as flight or even squadron leaders. They usually are promoted.

**SQUADRON LEADER COURSES.** Special courses for squadron leaders are conducted for pilots from front-line regiments and, in some cases, for highly qualified replacement air regiment graduates. The course includes ground school and approximately 50 hours of flying, in which simulated combat with captured enemy aircraft formerly was an important part.

**TRAINING OF "ACES."** During World War II a school for the training of aces existed, and still may be in operation. The original plan was to train highly qualified pilots from operational units for the formation of elite fighter regiments. This never was accomplished during the war, but elite regiments may be established in peacetime. The school used the most modern equipment in the Red Army Air Force and gave the most intensive pilot training in U. S. S. R.

**REPLACEMENT TRAINING.** The highest level of training for the great majority of Soviet pilots is carried on in the operational units. As in the USAAF, new replacements are taken on practice missions and formation and gunnery training continues. During World War II, replacements flew wing positions on short, easy missions, until they were trained thoroughly.

**AIR ACADEMIES.** At present there are two air academies in the Red Army Air Force. The Technical Academy trains command and staff officers, who have good engineering qualifications, for responsible technical assignments.

The Operational and Navigational (or tactical) Academy is a war college for command and staff

officers. Staff navigation officers, senior officers in the supply service, and unit commanders are trained. Qualifications and general educational standards are high, and the capacity of the academy is relatively small. Flying officers receive further air training to prepare them for command of large units. Ground tactics are studied with almost the same detail as air force tactics. Air-ground cooperation receives special emphasis.

### 3. AIR CREW TRAINING AND REPLACEMENT

**a. *Sturman* training.** The early part of the training at *Sturman* schools is devoted entirely to theory, after which ground and flying training are carried on simultaneously. Subjects include navigation, bombing, photographic reconnaissance, gunnery, radio, tactics, meteorology, and general military courses. Navigation is emphasized, but apparently only dead reckoning and radio navigation are taught. Air training usually consists of from 70 to 80 hours of flying for practice in navigation, bombing, gunnery, and aerial photography.

Upon graduation from a *Sturman* school, personnel proceed to replacement air regiments where crews are formed and trained as a unit before joining a front-line regiment.

**b. Specialists schools.** Before World War II, both radio operators and aerial gunners were given fairly extensive training in separate schools. During the war, all enlisted personnel were taught in the same specialist school. Aerial gunners and wireless operators were trained together and were almost interchangeable.

The 6-month course included training in armament, ballistics, theory of aerial gunnery, practice firing (air and ground targets), receiving and transmitting code, aircraft recognition, tactics, and general military subjects. Armament was emphasized because air crew personnel frequently perform ordnance and maintenance duties.

It is probable that wireless operator and aerial gunnery courses now are separate. Also, it is likely that both are more extensive than the hasty courses of World War II.

Upon graduation from a specialist school, air crew personnel proceed to replacement air regiments, where they are formed into crews and receive further training as a unit. A small percentage of wireless operators and aerial gunners are assigned to the Long Range Force, instead of replacement air regiments, and there receive further special training.

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Also, a few exceptional radio operators are sent to more advanced schools for preparation for duties in aircraft-warning and navigational-aid stations.

#### 4. GROUND CREW TRAINING AND REPLACEMENT

During World War II, training in an air force specialist school was flexible. The interchange of personnel after graduation was an accepted procedure. Not only did air crew members perform maintenance duties, but maintenance personnel were used as aerial gunners.

Probably the most detailed training given in a specialist school was that for "weapon specialists," who received more extensive armament maintenance training than was taught in the aerial gunnery course. The training of "engine maintenance" men was quite indefinite, and seemed to qualify the graduates only for cleaning and servicing aircraft.

All maintenance training was inadequate and rather informal during World War II. "Mechanics," who are the actual crew chiefs, were selected in the units from the "engine maintenance" men who had learned enough by practical experience or had special qualifications attained in civilian life. Of the "mechanics," the best qualified were sent to schools for aircraft technicians or were appointed "technicians" in the operational units. A "technician" is a commissioned officer comparable to the USAAF engineering officer. It is believed that this haphazard system was merely a wartime emergency measure, and that in time of peace efficient, well-organized schools will train maintenance personnel.

Special schools and promotions affect only a small minority of the Red Army Air Force ground personnel. Usually, graduates from air force specialist schools go to replacement air regiments for further limited training or go directly to front-line units, and never acquire special skill as mechanics.

#### 5. LONG RANGE FORCE ADVANCED TRAINING

**a. General.** A portion of the Long Range Force's training was completely independent of the usual Red Army Air Force program. However, the basic training, up to the point of graduation, often was given by the Red Army Air Force prior to the trainee's assignment to the Long Range Force. Although the Long Range Force was changed from an independent organization into an air army in December 1944, it is likely that this training system still is in operation.

**b. Pilot training.** Pilots for the Long Range

Force are trained by the Red Army Air Force through bomber service schools. Instead of going to replacement air regiments, they are assigned to the Long Range Force's "advanced officers schools for night crews," which are quite similar to replacement regiments in that all types of personnel are trained as a team.

In these schools, almost all pilot training consists of practical flying. There is great emphasis on night and instrument flying. The trainee receives approximately 100 hours in operational type aircraft.

**c. *Sturman* training.** All *Sturman* training for the Long Range Force is accomplished in special schools and is more advanced than standard Red Army Air Force training. There is special emphasis on night navigation, although bombing, gunnery, photography, and other standard subjects are included. The navigation training emphasizes radio navigation, but it is believed that celestial navigation is included.

Practical training consists of 100 hours of flying, of which 60 hours is at night. Upon graduation, *Sturman* enter "advanced officers schools for night crews," where they are assigned to air crews and receive further training.

**d. Air crew training.** The majority of its radio operators receive their entire air training from the Long Range Force. They are taught radio navigation and aerial gunnery in addition to the usual radio instruction. Most aerial gunners, however, receive their basic training in a standard Red Army Air Force specialist school. Both radio operators and aerial gunners, after completion of their training, are sent to "advanced officers schools for night crews" to receive further training with a complete air crew.

**e. Ground crew training.** Ground crew personnel of the Long Range Force, as well as aerial gunners, receive their pregraduate training in a standard air force specialist school. Upon assignment to the Long Range Force, some ground personnel receive further limited training. But, the majority are assigned directly to operational units.

**f. Bomber crew training.** All types of flying personnel of the Long Range Force assemble at "advanced officers schools for night crews," where complete crews are formed and trained as a unit. Practice missions are flown and further specialized ground school studies are continued.

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During World War II, there was additional training for bomber crews when they joined operational units. They flew practice missions during relatively quiet periods. New crews were sent on short, easy missions under good weather conditions for their first combat experience. Progressively more difficult missions were flown until the new crew was indoctrinated thoroughly. On some of the first missions, it was often the practice to send an experienced *Sturman* with an inexperienced pilot or an experienced pilot with an inexperienced *Sturman*. It is highly probable that, in peacetime, training in operational units will continue and even increase.

#### 6. AIR DEFENSE FORCES TRAINING

With the exception of practice in operational units, the Air Defense Forces have no special training system. During World War II, the pilots were drawn either from fighter service schools and replacement air regiments, or from pools of combat returnees, and sent to a replacement flight regiment for a short refresher course in first-line aircraft.

Although the Air Defense Forces did not get a good selection of pilots during World War II, it is probable that they now are receiving better pilots and are starting special ground-controlled interception training.

#### 7. TRAINING OF AIRBORNE TROOPS

The system for training Soviet air-borne troops is similar to that of the Red Army infantry. Officers are trained at special officer schools, noncommissioned officers are trained in depot regiments, and enlisted men are trained directly in the brigades. Although slightly more specialized, the training, with the exception of jump training, corresponds to standard infantry training: Personnel are drawn from all possible sources, and new inductees are accepted as readily as personnel from the Navy, Air Force, and the Red Army.

Physical, political, and educational requirements are extremely high. Airborne troops are doubtless the most elite arm of the Red Army. A further indication of the special character of these units is that convalescent and disabled personnel are returned to airborne units for staff duties.

**a. Enlisted training.** Training of enlisted men is planned to cover a 4-month period. Often, during World War II, it was shortened considerably. Two hundred and sixty hours of training are scheduled

each month. Maneuvers are conducted by progressively larger units as the course continues.

During the first month, tactics, weapons, maneuvers, and map reading are studied. There also is a limited amount of specialized engineer training. Jump training starts during the second month, and combat signal communications are added to the curriculum. Maneuvers involving companies are conducted during the third month. The size of the operations is increased gradually until, at the end of the 4-month period, several brigades may participate in the combat exercises. Frequently, these final maneuvers are conducted in cooperation with armored and mechanized units and airborne troops are given practice in the employment of antitank weapons and light, airborne field pieces.

**b. Officer training.** Training for officers is conducted at special schools. The course is planned to cover from 5 to 6 months. Much of the curriculum is similar to that for the enlisted men, but the major emphasis is placed on the command responsibilities of orientation and coordination of units.

### Section III. RED NAVAL AIR FORCE TRAINING

#### 1. GENERAL

The Red Naval Air Force is considerably smaller than the Red Army Air Force. However, this is a distinct advantage in that selection may be more careful and standards more easily maintained. This was especially noticeable during World War II, when the Red Naval Air Force replacement situation was not so critical as that of the Red Army Air Force. Because of this, naval air training courses remained nearer the peacetime level, and naval air crew members almost always were trained more thoroughly than those of the Army.

Red Naval Air Force training is similar to the Red Army Air Force program. The training system and schools are almost identical to those of the Army, but the curriculum in some of the courses is quite different because of the special nature of certain naval missions.

#### 2. TRAINING PROGRAM

Naval pilots start their formal training in elementary flying schools, which course is very similar to that in the Army schools. Upon completion of the course, students are sent to one of four naval flying

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training establishments for completion of pregraduate training.

The naval flying training establishments differ from the Red Army Air Force service schools in that most of them train air crew members as well as pilots. The First Naval Flying Training Establishment is the exception. It trains fighter pilots exclusively. The Second Naval Flying Training Establishment trains all naval bomber pilots and crews, the Third Naval Flying Training Establishment trains all ground attack pilots and crews. The Fourth Naval Flying Training Establishment trains pilots and crews for special torpedo bombing and mine-laying operations.

After graduating from these schools, pilots and crews formerly went to replacement air regiments for further training before assignment to an operational unit. This system, almost identical to the Army program, was discontinued in 1944 to save time. Pilots and crews were assigned directly to combat regiments for further training. However, in all probability, replacement air regiments again are operating as schools.

In addition, there are two small, special training schools. One is similar to the Red Army Air Force's special courses for squadron leaders, and performs an identical training function. The other school gives special transitional training in sea planes and flying boats.

The majority of naval fliers receive their most advanced training in a tactical regiment. This usually is more extensive than the regimental training in the Red Army Air Force, and is considered

one of the most important stages of training in the Red Naval Air Force.

## **Section IV. CIVIL AIR FLEET TRAINING**

### **1. WARTIME TRAINING**

Independent Civil Air Fleet training was well established before World War II, but during the war this program suffered from its subordination to military needs and the many subsequent emergency changes. In the early part of the war, many Civil Air Fleet schools were taken over by the Red Army Air Force. Later, Civil Air Fleet personnel were subject to transfer to the Red Army Air Force and the Long Range Force. Also, it appears that the Civil Air Fleet training was shortened to 18 months, and the program became more similar to that of the Red Army Air Force, possibly to facilitate transfers of personnel to the latter. However, it is reasonable to suppose that Civil Air Fleet training has returned to the prewar program.

### **2. PREWAR TRAINING**

Prior to World War II, the Civil Air Fleet was carrying out a fairly extensive training program. Physical and mental requirements for entrance were high and probably generally similar to peacetime military standards. Students who were being trained for foreign routes were given considerable language training. The duration of training was 2 years, but it is believed that an additional 2 years of apprenticeship and instruction, while serving as a copilot, was customary.

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## PART IV. LOGISTICS

### Section I. REPAIR AND MAINTENANCE

#### 1. RED ARMY AIR FORCE

**a. History and development.** In the early organization of the Red Army Air Force, the individual flying units had their own maintenance and repair equipment and technical ground personnel. This proved to be a cumbersome organization and limited the mobility of the flying unit.

In the general reorganization of the Red Army Air Force in 1927, an attempt was made to separate the ground service organizations from the flying units. Air parks were established. They varied in size and strength according to the type of unit they were designed to service. The largest air park, which serviced heavy bombers, included approximately 1,000 personnel. Its commander was assisted by a staff. The unit's functions were divided into two sections. The Technical Section was responsible for the supply of fuel, lubricants, ammunition, and technical personnel assigned to repair shops, garages, etc. The Administrative Section was responsible for rations, clothing, and equipment and performed the housekeeping duties of the unit. An airfield company, an antiaircraft defense company, a searchlight platoon, a chemical platoon, a weather station, and a fire prevention squad also were attached. Although the air park was an independent unit, it was attached to a flying unit and was subordinate to that flying unit.

In 1936 the air parks were reorganized into air bases. Internal organization remained about the same, but the air base was subordinate to the flying unit serviced only for operations. In all other respects, it was subordinate to the Chief of the Engineer Service of the Military District in which it was located.

It became evident by 1940 that the air bases did not meet the changing demands of modern aerial warfare, and the present system of regional commands of aviation ground services was put into effect. The Chief of the Main Administration of the Engineers directs the activities of the repair and maintenance organizations in the Red Army

Air Force. His only connection with the Regional Command of Aviation Ground Services is his dependency upon it for the spare parts and material needed by the small mobile aircraft repair shops (PARM-1) attached to the flying units.

**b. Classification of repairs.** There are four classifications of repair in the Red Army Air Force:

Minor—requiring up to 50 man-hours of labor.

Running—requiring up to 700 man-hours of labor.

Damage—requiring up to 1,250 man-hours of labor.

General (overhaul)—requiring more than 1,250 man-hours of labor.

Minor and running repairs are "field repairs" and usually are accomplished by the ground personnel of the air regiment and/or the mobile aircraft repair shop (PARM-1) attached to the air regiment.

Damage and general repairs are "major repairs." They are performed by the larger mobile aircraft repair shops (PARM-4 and 5) attached to an air army or a military district, by railway aircraft repair shops, and by static aircraft repair shops. There also are a number of repair shops within the aircraft industry, located in the rear areas, which are available to the Red Army Air Force for major repairs.

The removal of damaged aircraft is the duty of the nearest Airfield Servicing Battalion. Removal must be accomplished within 3 days of the report of damage.

Before an aircraft can be sent to one of the major repair units, permission must be obtained from the chief engineer of the air army to which the aircraft is assigned.

**c. Types of repair organizations.** The types of repair organizations include mobile aircraft repair shops (PARM), mobile aircraft repair bases, railway aircraft repair shops, static aircraft repair shops, and motor transport repair units.

Mobile aircraft repair shops are of several types, PARM-1 through PARM-5. The numeral indicates the number of repair trucks in the organization. PARM-1's are subordinate to mobile air-

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craft repair bases for administration, and to the Chief Engineer of the Air Regiment to which they are attached for operations. They perform minor and running repairs which cannot be handled by the ground personnel of the air regiment. PARM-2's to PARM-5's are under the jurisdiction of the major repairs department of the Chief of the Main Administration of the Engineer Service. They normally are located in rear areas for the performance of major repairs. But, they may be located near the front lines for the performance of mobile repair services.

Mobile aircraft repair bases are administrative organizations which operate under the direction of the field repair department of the Chief of the Main Administration of Engineer Service. They usually are attached to an air division, through which they control the PARM-1's attached to the air regiments.

Railway aircraft repair shops are large organizations consisting of approximately 30 railway cars fitted as workshops to perform high echelon repair. They operate under the immediate supervision of the major repairs department.

Static aircraft repair shops also are subordinate to the major repairs department, and are attached to an air army or a military district. They are large, permanently constructed shops equipped to perform the most difficult repairs.

Motor transport repair units include static motor transport repair shops, which perform major repair and overhaul on motor transport equipment, and mobile motor transport repair workshops, trucks equipped to perform minor repairs on motor transport vehicles.

**d. Repair and maintenance of training organizations.** Repair and maintenance service for schools, reserve air force regiments, etc., differs only in principle from that of the tactical units of the Red Army Air Force. In tactical organizations, the airfield servicing battalion is subordinate to the Commander of the Air Regiment to which it is attached for operational matters only, and otherwise is independent of his command. Maintenance and repair in a training organization is the responsibility of the Chief of Material-Technical Supplies who is subordinate to the Chief of the Training Organization and is his deputy for the maintenance

and supply of the training organization. His organization maintains its own workshops for field repairs.

## **2. LONG RANGE FORCE**

Until December 1944, the Long Range Force was a bomber force entirely independent of the Red Army Air Force. In its ground service organizations, there was no system to correspond to the regional commands of aviation ground services of the Red Army Air Force. Each air regiment had an airfield servicing battalion attached, which performed all servicing and maintenance for the regiment and which moved with it when the regiment changed bases. High echelon repairs probably were made in the rear areas in workshops of the air industry or of the Civil Air Fleet.

In December 1944 the Long Range Force became an air army and was incorporated into the Red Army Air Force. It is probable that the system of repair and maintenance of the Red Army Air Force was adopted.

## **3. FIGHTER AVIATION OF AIR DEFENSE FORCES**

It is believed that the ground organization of the fighter aviation of the Air Defense Forces parallels that of the Long Range Force prior to its incorporation into the Red Army Air Force.

## **4. CIVIL AIR FLEET**

Civil Air Fleet units utilized for military duty are serviced by airfield servicing battalions and mobile aircraft repair shops (PARM). This repair and maintenance service corresponds to that of the Red Army Air Force. Major repairs and overhauls are accomplished by the workshops maintained by the Civil Air Fleet.

No servicing installations or organizations comparable to the airfield servicing battalion of the Red Army Air Force exist in the Civil Air Fleet for units operating on air routes or in rear areas. Each unit makes use of the maintenance and repair services at the various airports the Civil Air Fleet has at its disposal.

## **5. RED NAVAL AIR FORCE**

Repairs are made by naval air bases, which are attached to the flying units at a division level. Each naval air base has several mobile aircraft repair shops (PARM), one of which is attached to each air regiment in the division. One large repair shop is located at the air base for higher echelon maintenance and repair.

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## Section II. SUPPLY

## 1. RED ARMY AIR FORCE

**a. General.** The Red Army Air Force is dependent upon the Red Army for all supplies not peculiar to air units. The chief of the Rear Services of the military district or army group supplies the air force with rations, clothing and equipment, fuel and lubricants, etc. He also is responsible for rail transportation of those supplies. Under this arrangement, the army central depots are closely associated with the air depots and the advanced supply depots of the Red Army Air Force.

Special air force depots are responsible for the supply of all specialized air force equipment, such as aircraft engines, plane and engine parts, ammunition, flying equipment, etc.

The delivery of all types of supplies from the air army depot or railhead to air units is a function of the airfield servicing battalions.

**b. Supplies provided by the Red Army.** General supplies common to all arms are provided by the Red Army for air units.

**FUEL AND LUBRICANTS.** A stock record is kept in each air unit of the amount of fuel and lubricants on hand, from which a daily report is made. This report passes through the airfield servicing battalion and the regional command of aviation ground services via air army Chief of the Rear Services to the Fuel and Lubricants Administration of the Main Administration of the Rear Services of Red Army Air Forces. The Fuel and Lubricants Administration prepares a requisition for the replenishment of stock and forwards it to the Red Army Fuel and Lubricants Administration. Fuel and lubricants are transported by rail from the main fuel and lubricants depot in the U. S. S. R. and issued to the various air ground units. Occasionally, the Fuel and Lubricants Administration requisitions from the same section of the forward staff (army group) which places orders for issue with the main Army fuel depots. The airfield servicing battalions and the independent motor transport battalions are responsible for the delivery of fuel and lubricants from the distributing stations to the air units (fig. 22).

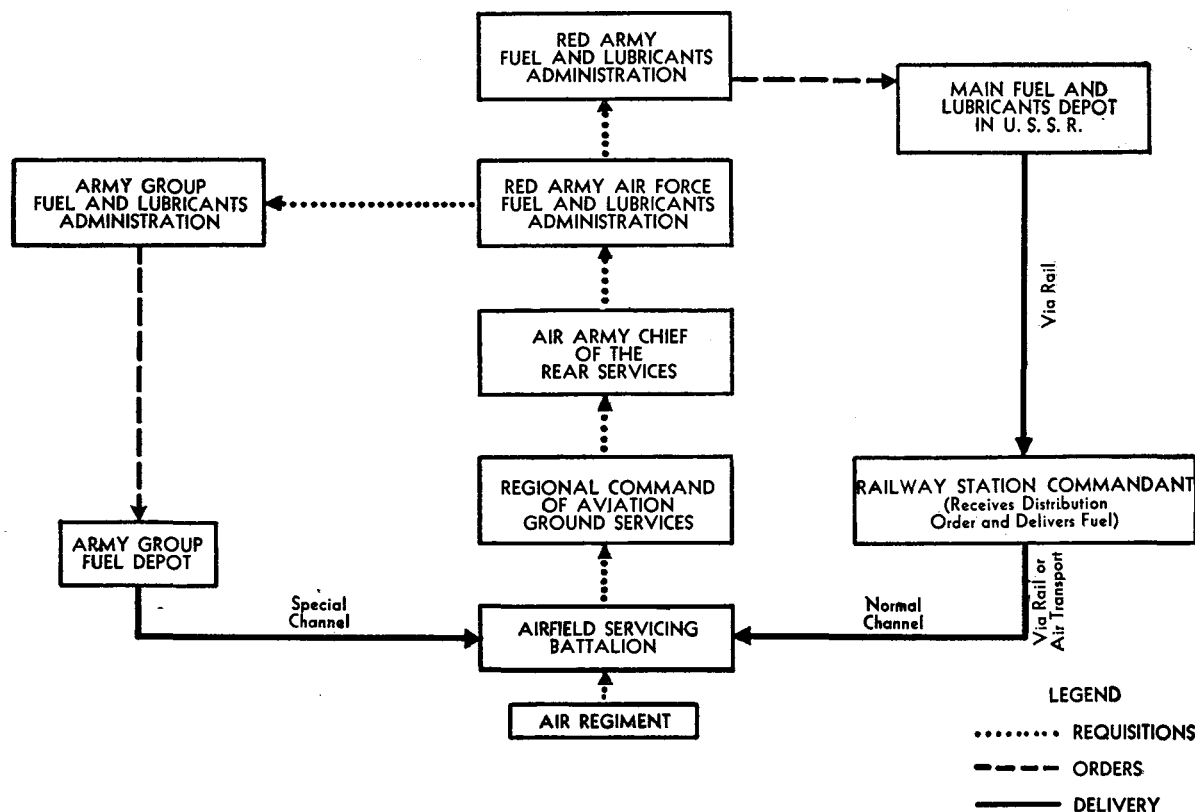


Figure 22.—Channels of requisition and supply for fuel and lubricants.

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**RATIONS, GENERAL ISSUE CLOTHING, AND INDIVIDUAL EQUIPMENT.** Requisitions are forwarded from the airfield servicing battalions through the regional command of aviation ground services and the supply section of the air army Chief of the Rear Services to the army group Chief of the Rear Services for approval. Supplies are furnished by the army group depots to the air ground units. Transportation is furnished by the airfield servicing battalions (fig. 23).

When transport planes are needed, they are requisitioned from the Air Transport Section of the Main Administration of the Red Army Air Force (fig. 24).

**SPARE PARTS, ETC.** Requisitions for and the supply of spare parts, etc. to air units follow the same channels as ammunition.

**d. Transportation of supplies by air.** When the distances to be covered by motor transport are excessive, when road conditions are unfavorable, or when the supplies are needed urgently, delivery is

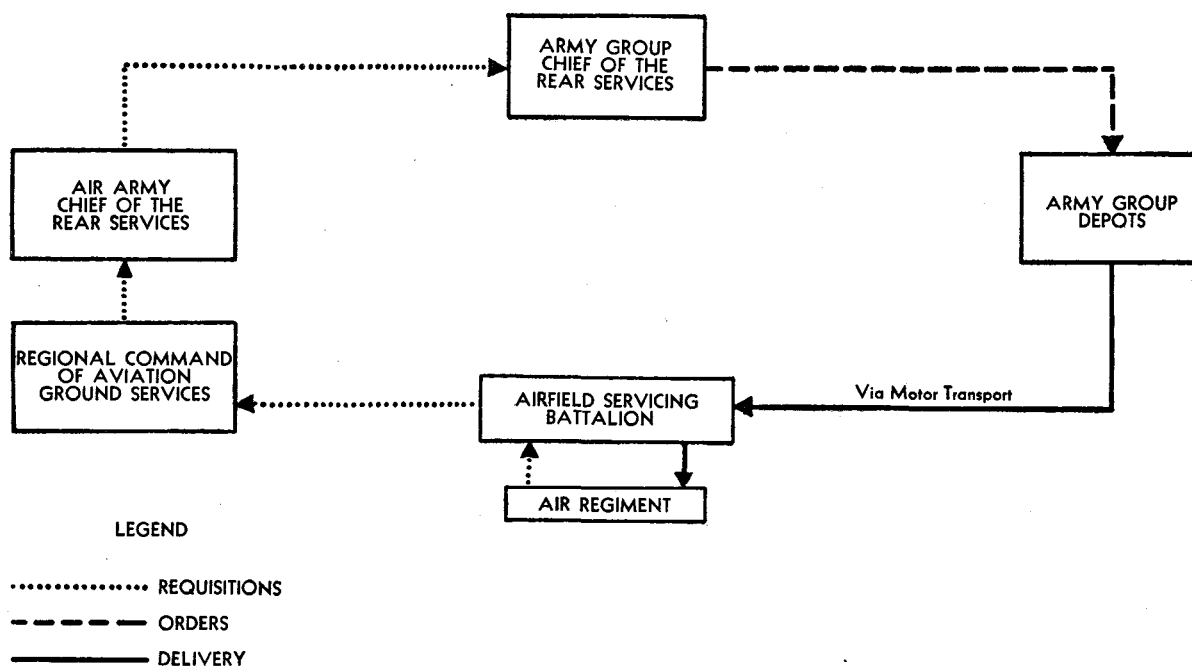


Figure 23.—Channels of requisition and supply for rations, general issue clothing, and individual equipment.

### c. Supplies provided by air force depots.

**AMMUNITION.** A stock record of ammunition and bombs is maintained by the airfield servicing battalion, from which a daily report is prepared for the regional command of aviation ground services. If replacements are needed, a requisition is forwarded via air army Chief of the Rear Services to the Administration of Technical Supply of the Main Administration of the Rear Services of the Red Army Air Force, which approves the requisition and orders the ammunition forwarded either from the main depot or directly from the factory to the advanced supply depot. It is delivered by the airfield servicing battalions or the independent motor transport battalions. Delivery normally is made by truck. But, if the distance exceeds 125 miles or road conditions are unsuitable, delivery may be made by air.

made by air transport. Transport aircraft are requisitioned from the Air Transport Section of the Main Administration of the Red Army Air Force.

**e. Supply of training organizations.** The supply system for schools, reserve air force regiments, etc., differs only in principle from that of the Red Army Air Force. In tactical organizations, the airfield servicing battalions are subordinate to the commander of the air regiment to which it is attached for operational matters only, and otherwise are independent of his command. The responsibility for supply in a training organization lies with the Chief of Material-Technical Supplies, who is the deputy for maintenance and supply of the chief of training organizations.

**f. Estimated daily requirements of an air force necessary to support one ground army.**

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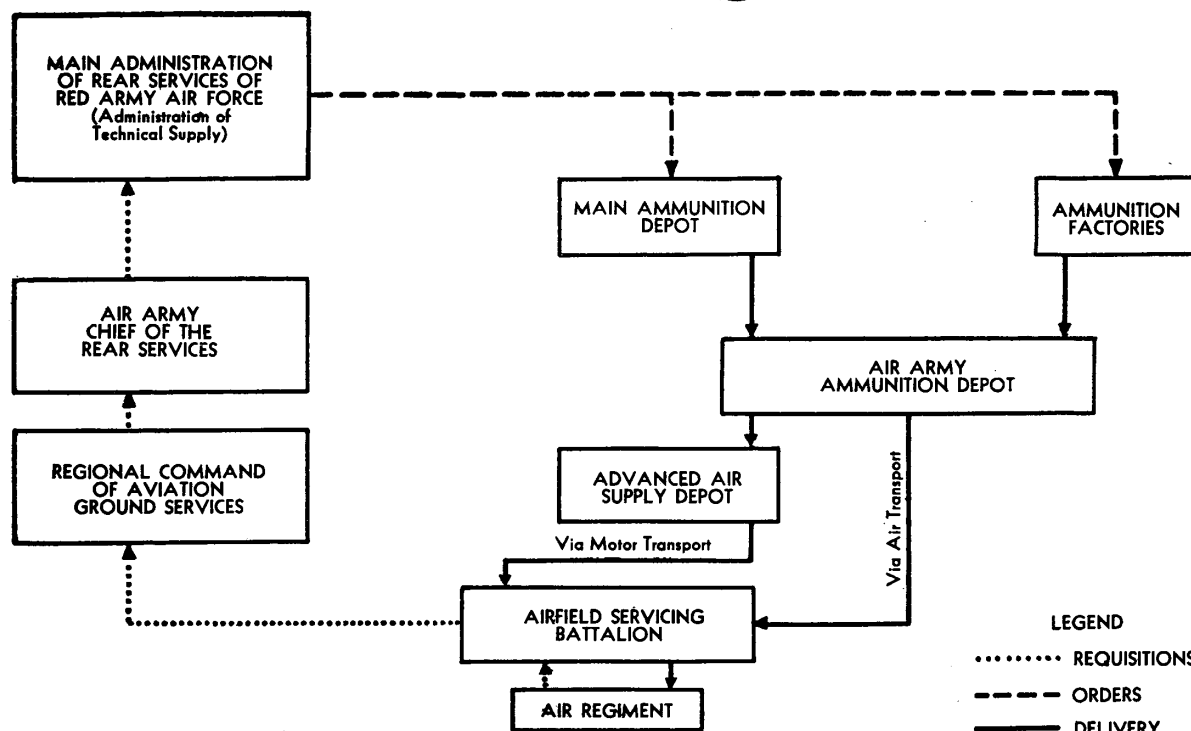
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Figure 25.—Estimated daily supply requirements for an air force necessary to support one ground army.

Based on a general analysis of Red Army Air Force supply organization and equipment, it is believed that the organic transport of the ground establishments is adequate not only to supply a normal type of air effort, but also to allow an ample margin for the movement of airfield equipment and installations. However, the transportation facilities assigned to airfield servicing battalions must be augmented by vehicles from the army transportation pool to move airfield equipment and installations for ground attack and bomber regiments.

An estimate has been made of the daily supply requirements necessary for air units normally supporting a ground army (fig. 25). This estimate is based on Soviet practice on the Eastern Front during World War II of supporting each rifle division with approximately one air regiment. It is estimated that the normal supporting air force for a ground army consists of three fighter, two ground-attack, two short-range bomber, one reconnaissance, and one miscellaneous air regiments. Supporting ground units are estimated at one regional com-

Type of regiment	Strength			Requirements						
	Number of regiments	Personnel	Planes	Class I	Class II	Class III	Class IIIA	Class IV	Class V	Aggregate
Fighter.....	3	456	120	Short tons 1.19	Short tons 0.75	Short tons 3.77	Short tons 44.58	Short tons 3.52	Short tons 33.92	Short tons 87.83
Ground attack.....	2	446	80	1.11	.74	1.84	29.72	1.72	111.78	146.91
Bombardment.....	2	560	60	1.4	.93	4.63	64.43	4.32	75.74	151.45
Reconnaissance.....	1	220	30	.55	.36	1.82	11.14	1.7	10.34	25.91
Miscellaneous.....	1	220	30	.55	.36	1.82	11.14	1.7	9.16	24.73
Total.....	9	1,902	320	4.8	3.14	13.88	161.01	12.96	240.94	436.73
Ground establishment.....	1	8,250		20.62	13.65	68.3		63.77		166.34
Aggregate.....		11,152		25.42	16.79	82.18	161.01	76.73	240.94	603.07

Figure 25.—Estimated daily supply requirements for an air force necessary to support one ground army.

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mand of aviation ground services and nine airfield servicing battalions. Estimates for munitions, fuel, and lubricants are based upon the official Soviet-reported average of three sorties daily per each fighter and ground attack regiment and two sorties daily per each twin-engine bomber, reconnaissance, and miscellaneous air regiment.

The distances of the airfields from the front lines, the distances between the airfields and the unloading station, and the number of trucks required are presented in figure 26.

Regiments	Distance from front lines (miles)	Average hauling distance (miles)	Trucks required
3 fighter .....	20	115	30
2 ground attack .....	45	85	50
2 bomber .....	45	85	50
1 reconnaissance .....	20	115	9
1 miscellaneous .....	20	115	9

Figure 26.—Length of supply lines and number of trucks required to supply air regiments.

## 2. LONG RANGE FORCE

Until December 1944, the Long Range Force was a bomber force entirely independent of the Red Army Air Force. In its ground service organization, there was no system to correspond to the regional command of aviation ground services of the Red Army Air Force. Each air regiment was assigned an airfield servicing battalion, which handled all supply matters and which moved with the air regiment when it changed bases.

In December 1944 the Long Range Force became an air army and was incorporated into the Red Army Air Force. It is believed that its present supply system is the same as that of the Red Air Force.

## 3. FIGHTER AVIATION OF AIR DEFENSE FORCES

It is believed that the ground organization of fighter aviation of the Air Defense Forces parallels that of the Long Range Force prior to its incorporation into the Red Army Air Force.

## 4. CIVIL AIR FLEET

When the Civil Air Fleet is operating on air routes or in rear areas, it has no service organization comparable to that of the Red Army Air Force. Each unit makes use of the supply services available at the various airports at the disposal of the Civil Air Fleet.

Those units of the Civil Air Fleet which are engaged in military duty are assigned airfield serv-

icing battalions. It is believed that all systems of procuring supplies available to the Red Army Air Force also are available to these units of the Civil Air Fleet.

## 5. RED NAVAL AIR FORCE

As the Red Army Air Force is dependent upon the Red Army for general supplies, so is the Red Naval Air Force dependent upon the Red Navy for its general supplies. However, the Red Naval Air Force is believed to be independent of the fleet for its supply of fuel and lubricants. Aircraft engines, plane and engine parts, special equipment, fuel and lubricants, etc., are procured from special air depots. These special air depots include the central depot of the Red Naval Air Force and the Red Naval Air Force depots attached to the individual air fleets.

# Section III. SUPPLY AND REPLACEMENT OF AIRCRAFT

## 1. GENERAL

The same systems of supply and replacement of aircraft (fig. 27) are used by all units of the Red Army Air Force, the Long Range Force, Fighter Aviation of the Air Defense Forces, and the Red Naval Air Force.

When aircraft production exceeded the immediate demands of the Soviet air forces toward the end of World War II, aircraft were sent from the factory to stored reserve or replacement air brigades and then to replacement air regiments, which delivered them to the flying units. This system was used chiefly for the replacement of air crews and aircraft. If aircraft replacements only were needed, delivery was made from the factory rear area stored reserve or replacement air brigades to the flying units in need of replacements.

In addition to the normal delivery systems, another method was used in 1944 for the re-equipping of flying units with new types of planes. This method, which was the delivery of aircraft directly to the flying regiment from the factory, or in a few instances through the replacement air regiments, was used only to supply a few front-line fighter and ground attack regiments with new type aircraft.

## 2. FERRY SYSTEM

Assembled aircraft at the factories are taken to factory airfields, test-flown, and delivered to the air force representative. When accepted, they are turned over to special ferrying squadrons, which

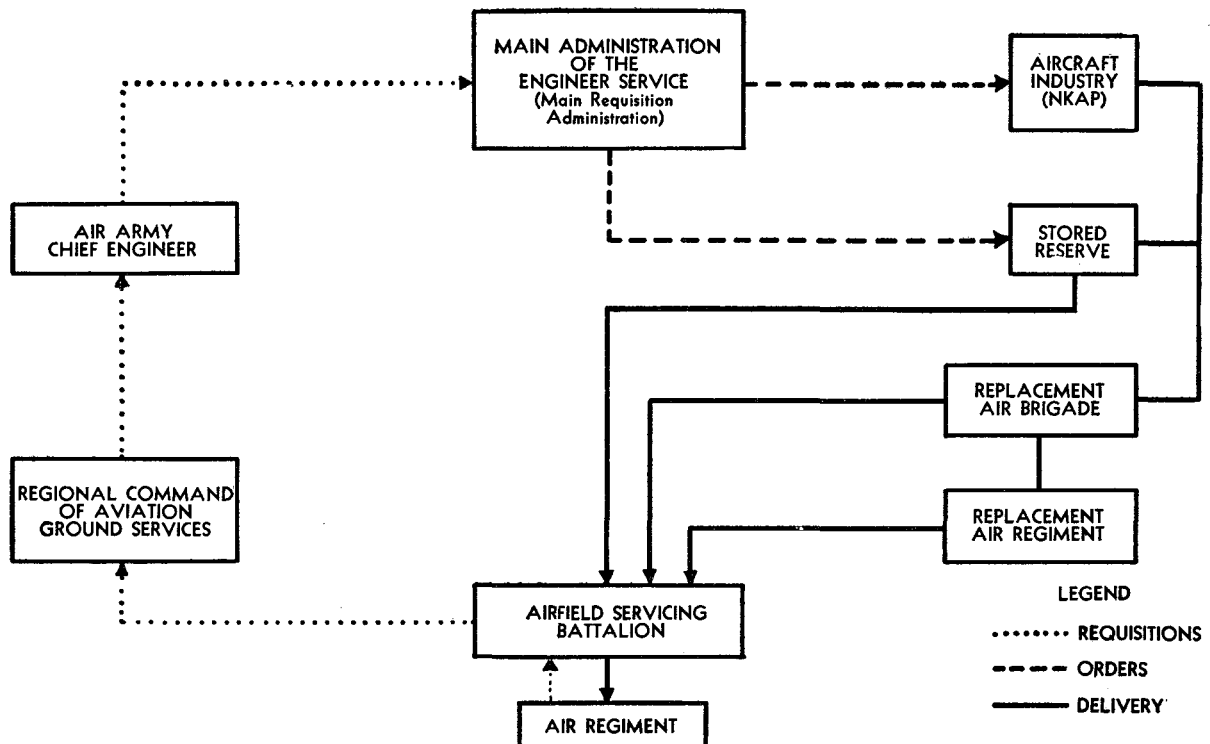
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Figure 27.—Channels of requisition and supply for aircraft.

are a part of the replacement air brigades. The planes are flown from the factory airfield to those of the replacement air brigades. In 1943 new aircraft ordinarily went directly to the front. But, late in the year, when aircraft production began to exceed the demands of the air forces, planes went to reserves, from which they were delivered to units. Older series were delivered first, and the reserve was augmented constantly with new aircraft from the factories.

Toward the end of World War II, when flying units were being re-equipped with new types, aircraft were delivered by selected pilots of the units being re-equipped. Thus, the pilots gained experience with the new type plane. The flying units also picked up new type aircraft at the replacement air brigades and flew them to the front. This pick-up system was continued until a large part of the unit's crews were thoroughly familiar with the new plane. Thereafter, replacements were delivered through the usual channels.

### 3. TRANSPORTATION OF AIRCRAFT BY AIR AND RAIL

Ordinarily, aircraft are flown to front-line and reserve flying units. But, toward the end of World

War II, many were delivered by rail. Light single-engined planes usually were delivered by rail when they were intended for reserve units behind the front.

Aircraft manufactured at distant plants sometimes were shipped by rail to the replacement air brigades, where they were taken by the replacement air regiments and flown to the flying units.

When new aircraft were stored in reserve, they later were flown to airfields holding immediate reserves for the front. They usually were flown by ferry squadrons or, in cases of necessity, by crews of operational units in the area. Occasionally, they were shipped by rail to relieve the burden on the ferrying squadrons. From the reserve airfields immediately behind the front, the planes were flown to the operational units only by crews of the operational units.

Control of aircraft supply and replacement is a function of the Administration of Technical Supply. From mid-1944, the Technical Supply Administration concentrated a portion of the reserves in areas near the front line and turned them over to the air armies. The administration replenished these reserves in accordance with the general reserve policy.

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Administration and distribution of these reserves were handled independently by the air armies.

#### 4. MAINTENANCE OF AIRCRAFT STRENGTH

In 1943 air regiments which were to operate in sectors of the main effort were brought up to full strength and received reinforcements during operations. Replacements were furnished only at the end of operations, and badly depleted units were withdrawn from the front.

In 1944 an attempt was made to maintain the strength of all units by constant replenishment. By 1945 all regiments approached table of organization strength. Air regiments in active areas received additional reserves prior to the beginning of operations. Thus, in many instances, actual strength exceeded table of organization strength. Establishment of reserves close to the front permitted replacement of losses during large-scale operations.

In areas of main effort, immediate reserves were established still closer to the front. In 1945 aircraft reserves were so large that air regiments not only could replace losses, but could replace aircraft requiring repair.

While the first regiments to be equipped with a new type of plane received their aircraft in the rear areas one or more of the new type was furnished the flying unit to retrain its personnel during operations. This practice avoided the necessity of returning the flying unit to a rear area for re-equipping and training.

Re-equipment was carried out at all times, even during intense activity. One and one-half to three weeks was the average time required to re-equip the first regiment receiving a new type of aircraft in the rear areas. This time was shortened considerably by the practice of re-equipping flying units at the front.

#### 5. SERVICE AND MAINTENANCE

**a. Serviceability report.** A daily report of the serviceability of aircraft on hand was made by all front-line air organizations throughout World War II. The reports included the following:

Operational losses on the previous day.

Nonoperational losses on the previous day.

Number of aircraft to be withdrawn for periodic overhaul, to be overhauled, or to be written off.

Number of serviceable operational aircraft on hand.

**b. Inspection of aircraft.** The following regulations for inspection of aircraft were issued by the Main Administration of the Engineer Service.

**PREFLIGHT INSPECTION.** All aircraft are to be inspected before flight by the aircraft mechanic, technician, and crew. The flight technician is to examine at least two aircraft daily, chosen at random. The regimental engineer and the armament and special equipment engineer are to inspect 15 aircraft, chosen at random, each month.

**PRESTART INSPECTION.** In case of repeated operations, this is to be performed by the crew and ground technical personnel.

**INSPECTION AFTER LANDING.** This is considered the most important inspection since all deficiencies and damage occurring during the flight must be established. It is to be carried out by technical crew members and technical ground personnel, under the supervision of the squadron technical officer.

**PERIODIC INSPECTION.** This is to be carried out only in units in rear areas, in flying schools, and in training organizations. In front-line formations, only regulation jobs are to be done, the period of which is laid down in instructions for technical maintenance of the different types of aircraft.

**INSPECTION OF AIRCRAFT AND ENGINES REACHING NORMAL LIMIT OF LIFE OR BECOMING DAMAGED.** The purpose of this inspection is to determine whether the aircraft in question, on the basis of its actual condition, still is suitable for further use. The degree of repair required is to be established as well as the necessity for transfer to a maintenance unit. It is to be decided whether the aircraft can be written off as battle weary. For the purpose of such inspections a commission, with the regimental engineer as chairman, is established by regimental order. When the examination reveals that the aircraft, despite the completion of the regulation number of flying hours, still is not in need of repair, the commission has the authority to prolong the regulation overhaul period of the aircraft by 30 percent and of the engine by 20 percent. The decision, however, must be confirmed by the chief engineer of the air army. Aircraft which are worn out or are unfit for service because of damage can be written off by the commission, although the inspector of the air army must make an inspection and complete a con-

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firmary certificate. Only then is the aircraft struck off the unit's records.

The chief engineers of the air armies forward monthly reports to the chief engineer of the Red Army Air Force. Details of the aircraft and engines, whose period of service life has been extended, are given in full.

The purpose of these inspections is to control the operational serviceability of aircraft and to supervise the operation of all regulations for their servicing. Inspection can be ordered by divisions, by corps, by air armies, by the Chief Engineer of the Red Army Air Force, or by the Inspector General or the Commander of the Red Army Air Force.

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## **PART V. AIRFIELDS**

### **Section I. ESTABLISHMENT OF AIRFIELDS**

#### **1. GENERAL**

Permanent Soviet airports have hangars, underground fuel storage, asphalt or concrete runways, and paved parking ramps. They are similar generally to peacetime military airdromes of the Western air forces. During World War II, the rapidly advancing Red Army needed many quickly constructed, temporary airdromes as bases for thousands of tactical aircraft. Many details of wartime airdrome construction are not applicable to peacetime practice but policies and procedures of location, selection, construction, and winterization are of military importance.

Many factors affected Soviet airdromes during World War II. The Soviet doctrine that the air force is almost exclusively a ground support arm greatly affected the location of airdromes and the duration of their employment. Also, the characteristics of the aircraft employed dictated the quality of the landing surfaces, length of field, and consequently the number of personnel and time required for construction.

The Soviets constructed advanced bases for minimum requirements of the aircraft to be based on them, and in the shortest time possible. Shelter for personnel, supply stores, maintenance facilities, and many services considered necessary by other large air forces almost never were installed by the Soviets.

#### **2. LOCATION**

Probably the main consideration in the location of airdromes was proximity to the front. In all cases, Soviet units were stationed much closer to enemy territory than was customary with corresponding units of the Western air forces. This was due, in part, to the shorter range of Soviet aircraft and partly to pronounced Soviet emphasis on immediate ground support.

Fighter aircraft were based from 15 to 30 miles from the front line, and ground attack units usually were stationed only from 20 to 65 miles in the rear. Bases from 20 to 80 miles from the front were nor-

mal for twin-engine aircraft and tactical bombers. Aircraft of the Long Range Force were the only combat aircraft generally stationed more than 100 miles from the front line.

The Soviets almost invariably located their fields where little or no earth removal and leveling were required. The lack of heavy equipment and the demands of the rapidly advancing Red Army made such extensive construction impractical. In addition, an adequate supply of sand, rock, and gravel within 3 miles of the proposed site was considered indispensable.

The construction of airfields was affected by the activities on the front. The areas facing the greatest enemy resistance or behind an anticipated enemy or Soviet offensive contained many more airfields than a quiet sector.

The requirements for transportation appear to have been modest, and access to roads and railroads relatively unimportant. Whenever possible, the Soviets located their fields near a patch of forest for dispersion and concealment of aircraft, but this was only a minor consideration.

#### **3. SELECTION**

Reconnaissance and preliminary selection of airdromes was done by groups of from six to eight men in vehicles, who moved up rapidly behind the infantry into newly acquired territory. These special crews usually were detached from regional commands of aviation ground services, airfield engineer battalions, or, less frequently, from airfield servicing battalions. An additional inspection of proposed sites was made by specialists from an airfield detachment. In the final choice of a site, the headquarters of the flying unit involved usually was consulted.

#### **4. FACILITIES**

Compared to Western standards, Soviet tactical airdromes constructed during World War II were quite primitive. They were considerably smaller in all dimensions. The landing surfaces and taxiway systems were greatly inferior in quality.

The Soviets attempted to provide fields approxi-

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mately 3,000 to 4,000 feet square for operational aircraft, but often they used a single strip for landing and take-off, frequently as narrow as 150 feet. Most of these temporary fields were fairly small, and usually only one regiment was stationed at each field. Liaison and hospital aircraft, however, often operated from fields offering a run as short as 1,000 feet. Parking areas and taxi ways were primitive, and all installations were cut to minimum requirements.

Night flying facilities for temporary airdromes were elementary. Most fields had no facilities at all. Those used as bases for night operations had only a flare path. The use of searchlights to illuminate the runway was exceptional.

## 5. CONSTRUCTION

Despite the lack of adequate equipment, temporary airdromes were constructed in an average of 3 days. A minimum of trained military personnel was employed. Many improvisations were used.

After evaluating the reconnaissance reports, the air army ordered the construction of the required airdromes. The actual construction then was undertaken and supervised by platoons or companies detached from airfield engineer battalions. However, most of the labor was accomplished by the local civilians drafted in the surrounding area. Personnel from the airfield engineer battalions usually limited their activities to supervision and highly specialized construction. When the field neared completion, the airfield engineer battalion detachment usually moved on, leaving approximately 20 men to supervise the completion of the field. Once the field was occupied by a flying unit, any further construction was accomplished by the airfield technical company, which was attached to the airfield servicing battalion.

Although the major part of the construction was accomplished by manual labor, the Soviets did have some specialized heavy equipment. There was a very limited supply of bulldozers and bucket type scrapers. In most cases, however, the only mechanized equipment consisted of tractors and rollers requisitioned from nearby collective farms.

Although large-scale removal of earth was avoided, bomb craters and ditches were filled in and slight ridges often were leveled off.

The surface of landing strips usually consisted of rolled earth with sand or gravel added to harden

the surface and to facilitate drainage. Concrete was not used on temporary fields. The Soviets used steel plates and road metal on their strips only after 1944, and then on less than 10 percent of the fields. In the marshy areas of the northern U. S. S. R., runways often were constructed on a foundation of waste wood, brush, and sawdust.

Tactical airdromes in the forward areas were considered ready for use when a relatively safe strip had been completed. Hangars never were installed. Aircraft had to be sent to the rear for repairs beyond the second echelon level. Blast bays for aircraft were constructed only during the early part of World War II, when the German Air Force was an effective offensive force. Administration buildings and operations rooms were usually dugouts or small wooden huts. Personnel usually were billeted away from the field.

Roads to airdromes were provided whenever possible. Supplies of fuel, oil, bombs, and ammunition were brought in from rear depots by personnel from the airfield servicing battalions. Trucks and horse-drawn vehicles were employed whenever possible. Air transport was used only in critical situations. When extremely poor transportation conditions existed, supplies were packed in by large numbers of civilians under supervision of the airfield servicing battalions.

## Section II. AIRFIELD MAINTENANCE

### 1. GENERAL

The main problem of Soviet airfield maintenance during World War II was the establishment of serviceable strips during spring thaws. Summer operations presented few problems. The use of sod kept dust at a minimum. Winter operations were more difficult, especially in the areas where intermittent snow storms and thaws occurred.

### 2. RESPONSIBILITY

Maintenance of airstrips was one of the duties of the airfield technical company stationed on a field. These units were attached to the airfield servicing battalions, and generally were charged with the maintenance of all installations. Large-scale snow removal usually was effected by the local civilian population under the direction of airfield technical company personnel. Equipment for winter maintenance consisted of a few tractors, used as prime movers for

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improvised plows, scrapers, and rollers. In rare cases, specialized graders and bulldozers were used.

### 3. WINTERIZATION

Two somewhat similar methods were used to winterize tactical airstrips. Both required almost continuous maintenance. The first method was to roll the snow into a firm surface shortly after it fell. Frequently, snowdrifts and ruts were leveled out just prior to rolling. The amount of snow removed usually was kept to a minimum. The second method was to scrape off nearly all the snow, leaving a surface of hard rolled snow less than 2 inches deep. The latter system generally was used where twin engine aircraft were expected to operate because a thick blanket of rolled snow often was too soft for heavy planes.

Whenever possible, the Soviets prepared both

types of strips on the same field. The rolled-snow strip was used where light aircraft were stationed because of quicker and easier maintenance. The scraped strip generally was used during the short thaws in winter and during the initial stages of the spring thaw when the rolled strip became soft.

Once the spring thaw was well under way, a third strip usually was prepared. When both types of strips previously mentioned became unsafe, an unused area was cleared. The earth beneath newly removed snow was not frozen deeply. If more cold weather was expected, the strip was covered with straw or branches. Drainage was facilitated whenever possible. When the unused strip finally was needed, the insulating material was removed and mud holes were filled with sand, gravel, or cinders. In this way, operations were not halted completely by thaws, although they probably were impaired.

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## PART VI. WEAPONS AND EQUIPMENT

### Section I. AIRCRAFT AND ENGINES

#### 1. GENERAL

At the outbreak of the war with Germany, the Red Army Air Force was equipped largely with such aircraft as the I-15, I-16, and I-153. Although these planes already were obsolescent and definitely inferior to their German counterparts, the Soviets possessed them in large numbers and committed them to battle regardless of losses.

New designs soon were tested and ready for production. Although a great need existed for all types of aircraft, the Soviets were forced to concentrate primarily on fighters and ground attack aircraft to replace battle losses. Mass production of these types was initiated. Designers and manufacturers concentrated on production with little regard for improvements or modifications. This condition prevailed until the Soviets had achieved parity in numbers with the German Air Force.

At this stage, although the situation at the front had eased considerably, the designers yet were not able to stop production of existing types and to introduce newer and more effective combat planes. Consequently, they embarked on a program of improving and modifying existing models. This policy continued until the early part of 1944, when the Soviets had gained numerical superiority over the enemy. Only then did Soviet designers and manufacturers begin to concentrate on new types of aircraft. It is believed that Soviet aircraft designers now will make every effort to improve the quality and effectiveness of their air forces.

**a. Prewar Soviet aircraft.** Prewar types of Soviet aircraft compared unfavorably with corresponding types of the Western air forces. Generally, they were slower, less powerful, had less fire power, and were of inferior construction. Many were built of wood and covered with fabric. These were easy prey for the German Luftwaffe. As a result, the Soviets suffered tremendous losses, which they could afford only because they possessed large numbers of aircraft. The designs for new planes, however, were ready. Prototypes had been con-

structed and tested, and the manufacturers were ready to begin production.

**b. Standardization.** After Germany invaded the U. S. S. R., operational needs demanded concentration of all production on fighter and ground attack types. The urgency was so great that factories had to make deliveries without regard for improvements or modifications once the production of new aircraft types had begun. These planes, although still inferior, were more evenly matched with their German counterparts. At this stage, the Soviets were striving desperately to achieve at least numerical parity with the enemy, rather than technical superiority.

**c. Improvement and modification of existing aircraft types.** The effort to gain numerical equality with the enemy invited stagnation in technical development. After numerical parity had been reached, introduction of newer and more effective types of aircraft became advisable, but could be accomplished only by again losing numerical equality. Yet, technical improvement was mandatory. Because existing models had achieved comparative success, it was decided to concentrate all effort on the improvement of these aircraft. By this time, the difference in performance between the Soviet and German aircraft was not so great, and, more important, an uncontested superiority over the enemy had been reached.

**d. Present status and the future trends of Soviet aircraft.** The policy of standardization on a few types of aircraft, and later a decision to concentrate on the development and technical improvement of those types, enabled the Soviets to gain numerical superiority over and technical comparability with the Luftwaffe in the early part of 1944. Soviet designers then were free to embark upon a program of developing new aircraft designs. A marked improvement in quality of both aircraft and equipment was noted almost immediately.

By the end of World War II, the striking power of the Red Army Air Force had risen considerably, and while not yet on an equal basis with Western air forces it was high above its prewar level. While

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working on new designs of their own, the Soviets devoted considerable time to the study of British and American planes obtained through lend-lease. Also, many of the latest German aircraft and equipment opened another source.

It is reasonable to assume that the most advanced improvements found in foreign aircraft will be incorporated, and perhaps improved, in future Soviet aircraft. Moreover, there are many indications that the Soviets have been experimenting with jet, rocket, and turbine development for some time.

## 2. AIRCRAFT DEVELOPMENT

**a. Fighters.** The Red Army Air Force had three basic fighter types at the outbreak of World War II, the I-15, I-16, and I-153. All had seen service in the Spanish Civil War. These obsolescent aircraft disappeared almost completely during the first few weeks of the war.

The LAGG-3 and MIG-3, the forerunners of modern Soviet fighters, were ready for production and reached operational units shortly thereafter. Somewhat later, the YAK-1 reached the production stage. Since a decision had been made to standardize aircraft types, the Soviets were confronted with the problems of deciding which of the three fighters was best adapted to the needs of the Red Army Air Force. The YAK-1 was selected and put into mass production immediately. There was a large reserve of YAK-7s, an advanced trainer, which was drawn upon. These advanced trainers were converted to fighters and met the requirements of the air force until the YAK-1 reached operational units.

In 1943, the YAK-9, of which there have been many derivatives, made its appearance. This was an improvement of the YAK-1, with little change in performance, but with better armament and improved rearward vision.

The YAK-3, a further development of the YAK-1 and YAK-9, made its appearance a short time later. The refinements of the YAK-9 were retained, weight was reduced, and there was an improvement in performance.

The Soviet counterpart of the FW-190 was put into action in 1943. This was the LA-5, a refinement of the discarded LAGG-3. Armament was increased, and speed and range were improved considerably.

In 1944, the LA-7, a development of the LA-5,

appeared in limited numbers. Weight was reduced by the more extensive use of light alloys, with the resulting improvement of maneuverability and rate of climb.

**b. Bombers.** At the outbreak of World War II, the Soviets had the AR-2, SB-2, SB-3, YAK-4, ER-2, DB-3, TB-3, and TB-7 bombers. These were obsolescent types which were destroyed largely in the first few weeks of operations. Only the DB-3, which was developed into the IL-4, and the TB-7, which later became the PE-8 and which was produced only in small numbers, became standard equipment.

The PE-2 was introduced in late 1941, and became one of the principal bombers of the Red Army Air Force.

The only new bomber of Soviet design to appear throughout World War II was the TU-2. It reached operational units late in 1944, but never in any large number. It was a greatly improved medium bomber, with heavier armament, a larger bomb load, and a better performance than any previous Soviet medium bomber.

The ER-4, an improvement of the ER-2, also appeared in 1944. It is a Diesel twin-engined bomber, with a normal bomb load of 4,000 pounds.

**c. Ground attack.** No specially designed aircraft for ground attack existed at the beginning of World War II. Until the IL-2 was developed, the light bomber SU-2, was used for such missions. The slow speed, poor maneuverability, and lack of rear guns of the first single-seat IL-2 Stormovik rendered it vulnerable to German fighters. In 1942 a second cockpit for a rear gunner was added.

Toward the end of the war, another version, the IL-10, began to appear in front-line units. It is an all-metal, lighter aircraft, powered with larger engines, and producing better performance.

Considerable use was made throughout World War II of the PO-2 (U-2) biplane trainer for low-level, precision, night bombing in close support of ground forces.

**d. Naval aircraft.** No new naval aircraft appeared during World War II. Naval aircraft include the obsolescent KOR-1, a single-engined, shipborne floatplane; the obsolescent MBR-2, a single-engined flying boat; the GST; and the MDR-6. With the exception of these planes, standard equip-

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ment for the Red Naval Air Force is the same as that used by the Red Army Air Force, with minor adaptations for specialized naval work.

**e. Lend-lease aircraft.** The Soviet air forces received the following aircraft from the United States: P-39, P-47, and P-63 fighters; A-20, DB-7, and B-25 light and medium bombers; C-47 transports; and AT-6's and O-52's. The British delivered Spitfire, Hurricane, Mosquito, and Typhoon fighters; Albermarle and Hampden light and medium bombers; and Stirling and Lancaster heavy bombers.

**f. Jet- and rocket-propelled aircraft.** Since 1942 the scientific research institutes of the Soviet Union have devoted considerable time to the research and development of jet- and rocket-propelled aircraft. The Soviets have obtained complete details of German equipment in their possession, which probably will be incorporated or adapted for Soviet use.

**g. Gliders.** There are three known types of gliders in the Red Army Air Force: The small A-7, the G-11, which is a larger version of the A-7, and the KZ-20.

**A-7.** This small, high-wing monoplane was designed primarily for landing agents behind enemy lines. It is towed usually by an IL-4 or an SB-3.

## CHARACTERISTICS

Span.....	59 feet.
Length.....	34 feet, 5 inches.
Weight (empty).....	2,260 pounds.
Weight (loaded).....	4,200 pounds.
Useful load.....	6 men or 1,870 pounds of freight.
Maximum speed (permissible).....	185 m. p. h.
Gliding speed.....	90 m. p. h.
Landing speed.....	53 m. p. h.
Landing run (on wheels).....	1,650 feet.
Length of tow rope.....	300 feet.

**G-11.** The G-11 is a modification of the A-7. It carries a useful load of 11 men or 2,640 pounds of freight.

**KZ-20.** The KZ-20 is a high wing monoplane for use as a troop and freight carrier. It is of wood and fabric construction, has a crew of two, and probably has a retractable landing gear and a skid for landing on rough terrain. It is towed by the IL-4 or SB-3. Span is estimated at 72 feet and length at 51 feet.

**h. Helicopters.** The twin-engined Omega helicopter, an original design by Bratukhin, is of all-metal construction and has a crew of two. It has a tricycle landing gear. Maximum horizontal speed is 112 miles per hour. Vertical climb is from 16 to 19 feet per second.

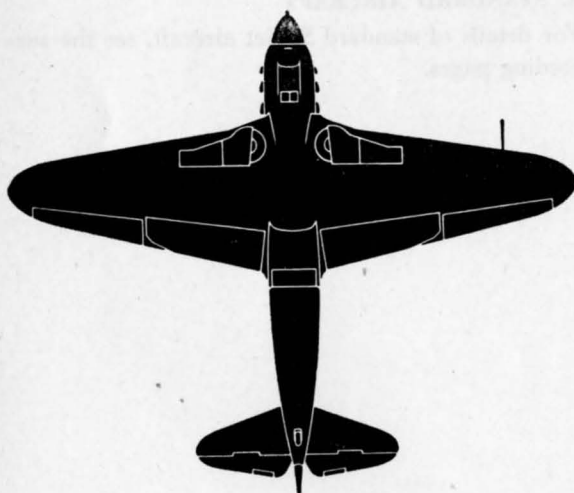
## 3. STANDARD AIRCRAFT

For details of standard Soviet aircraft, see the succeeding pages.

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## YAK-1 FIGHTER

Crew.....	1.
Span.....	32 feet, 10 inches.
Length.....	27 feet, 11 inches.
Wing area.....	188 square feet.

Maximum speed at altitude-----	348 m. p. h./16,400 feet.
Range-----	500 miles maximum.
Service ceiling-----	33,000 feet.
Armament-----	1 20-mm. 2 7.62-mm.

*Figure 28.*

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CONFIDENTIAL**YAK-3 FIGHTER**

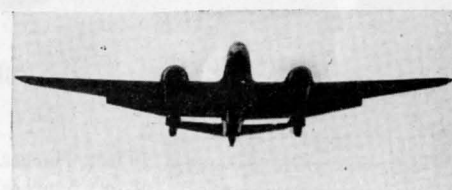
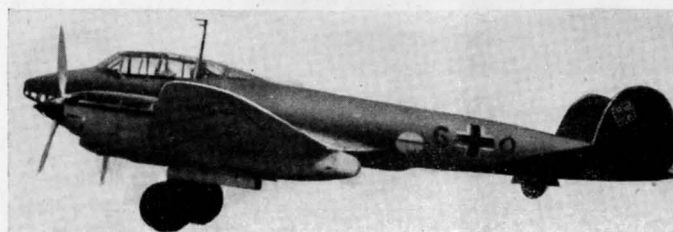
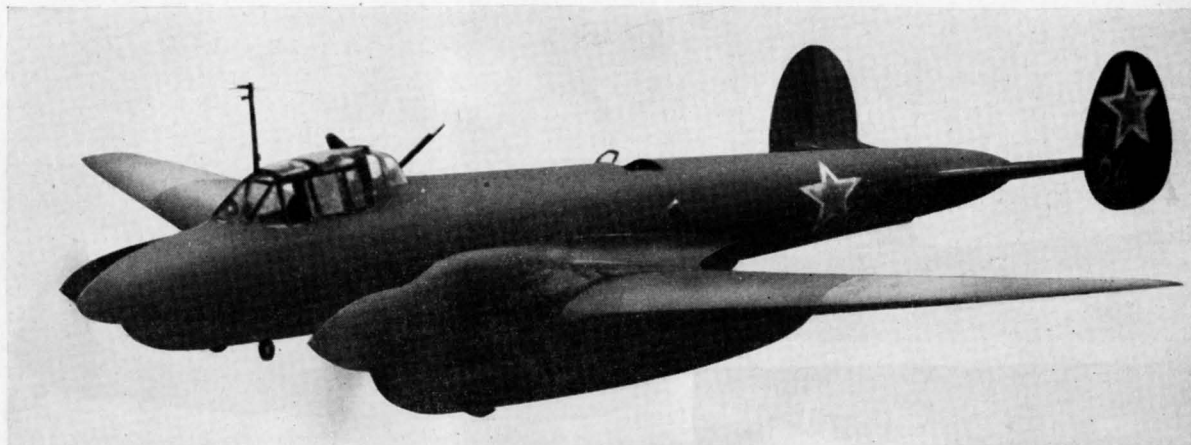
Crew.....	1.	Maximum speed at altitude.....	365 m. p. h./13,100 feet.
Span.....	32 feet, 10 inches.	Range.....	465 miles maximum.
Length.....	27 feet, 11 inches.	Service ceiling.....	35,000 feet.
Wing area.....	188 square feet.	Armament.....	1 20-mm. 2 12.7-mm.

*Figure 29.***RESTRICTED**  
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**PE-2 LIGHT BOMBER**

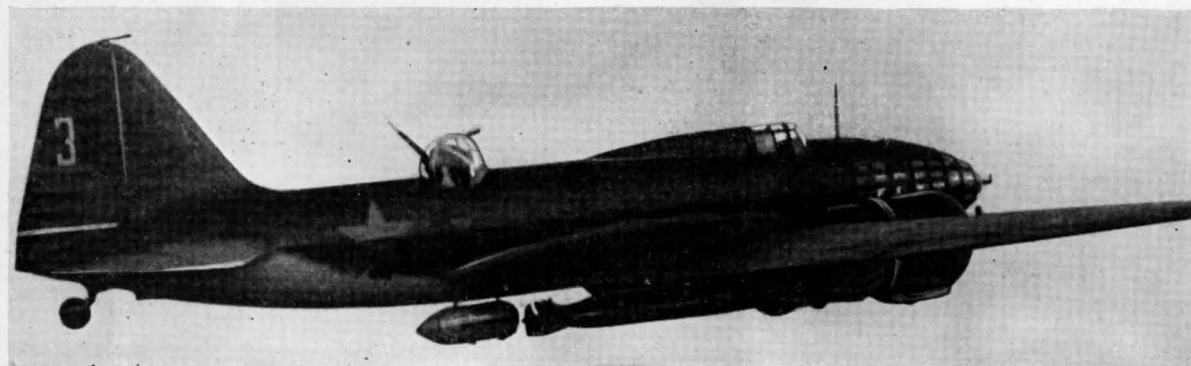
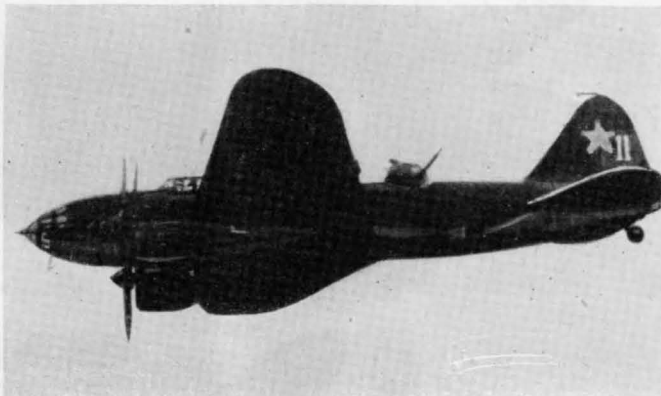
Crew----- 3.  
 Span----- 56 feet, 5 inches.  
 Length----- 41 feet, 6 inches.  
 Wing area----- 436 square feet.

Maximum speed at altitude----- 330 m. p. h./16,400 feet.  
 Range----- 930 miles (w/1,320 pounds  
 of bombs).  
 Service ceiling----- 29,000 feet.  
 Armament----- 2 12.7-mm.  
 3 7.62-mm.

*Figure 31.*

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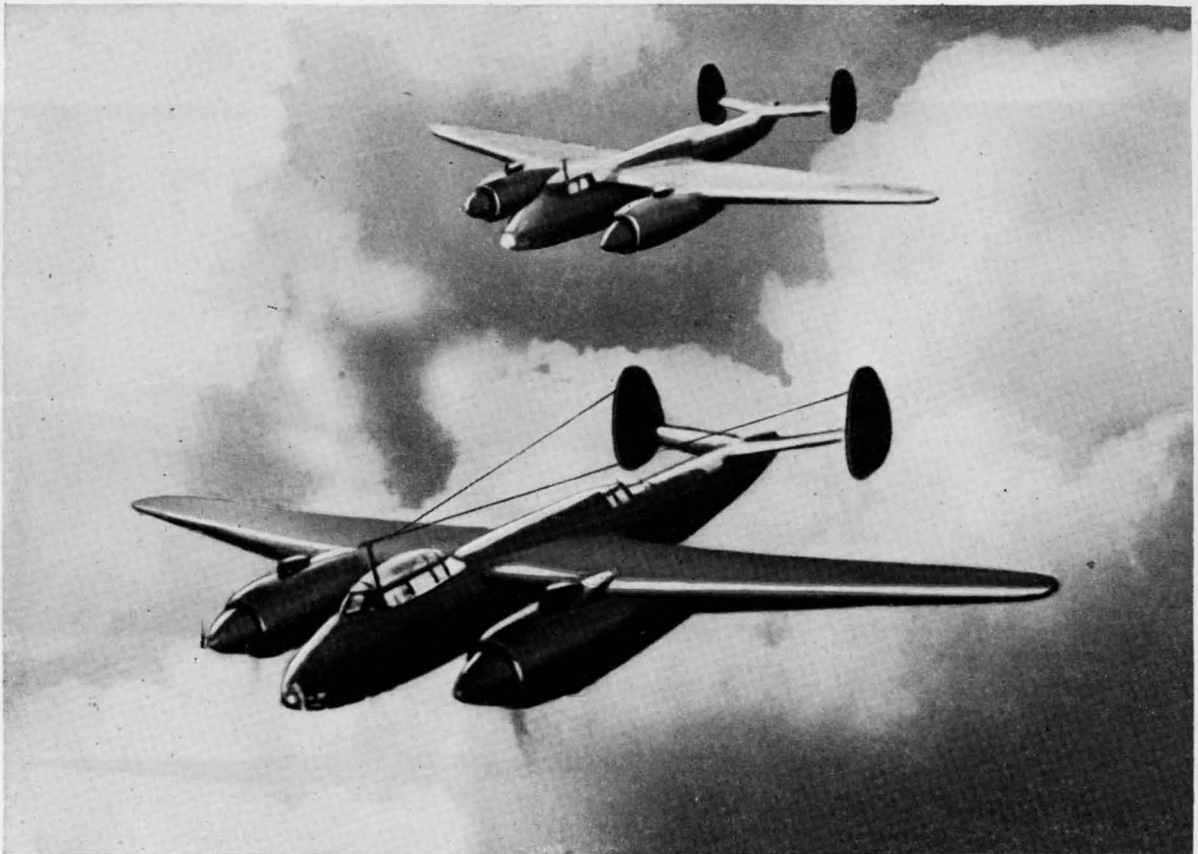
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**IL-4 MEDIUM BOMBER**

Crew----- 3.  
Span----- 70 feet, 3 inches.  
Length----- 48 feet, 6 inches.  
Wing area----- 715.8 square feet.

Maximum speed at altitude----- 280 m. p. h./22,300 feet.  
Range----- 810 miles (w/6,600 pounds  
of bombs).  
Service ceiling----- 33,000 feet.  
Armament----- 2 7.62-mm.  
1 12.7-mm.

*Figure 32.***RESTRICTED**  
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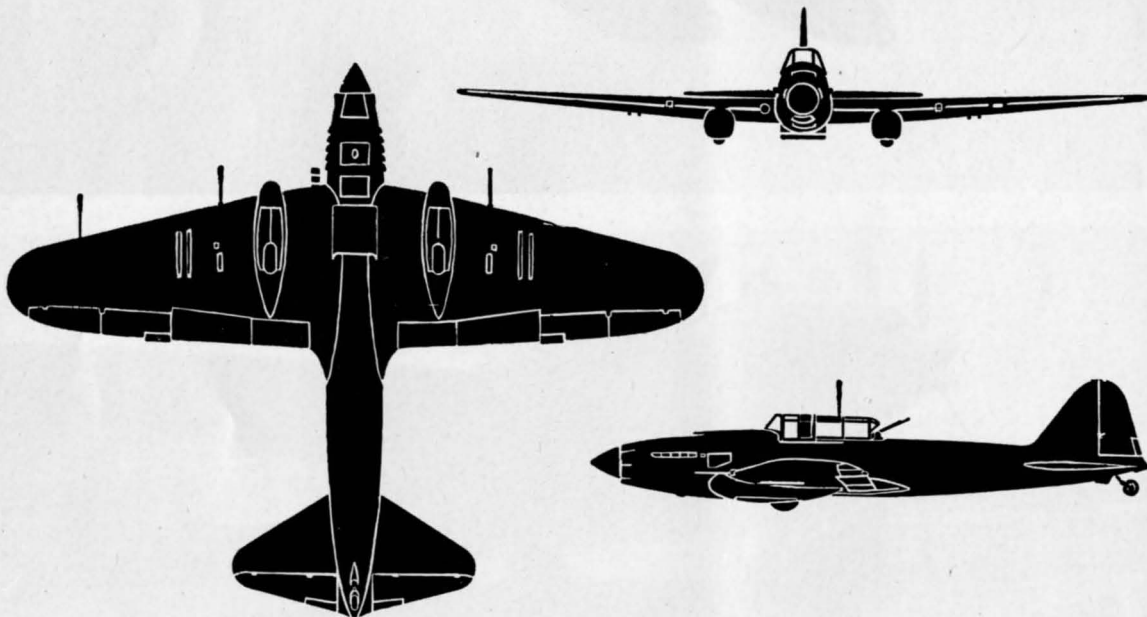
**TU-2 MEDIUM BOMBER**

Crew.....	3 or 4.	Maximum speed at altitude---	348 m. p. h./19,000 feet.
Span.....	61 feet, 10 inches (est.).	Range.....	1,550 miles (w/3,000 pound of bombs).
Length.....	45 feet, 3 inches (est.).	Service ceiling.....	33,000 feet.
Wing area.....	615 square feet (est.).	Armament.....	2 20-mm. 3 12.7-mm.

Figure 33.

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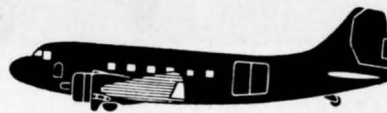
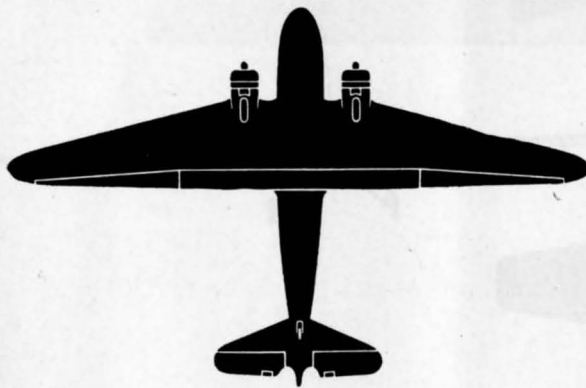
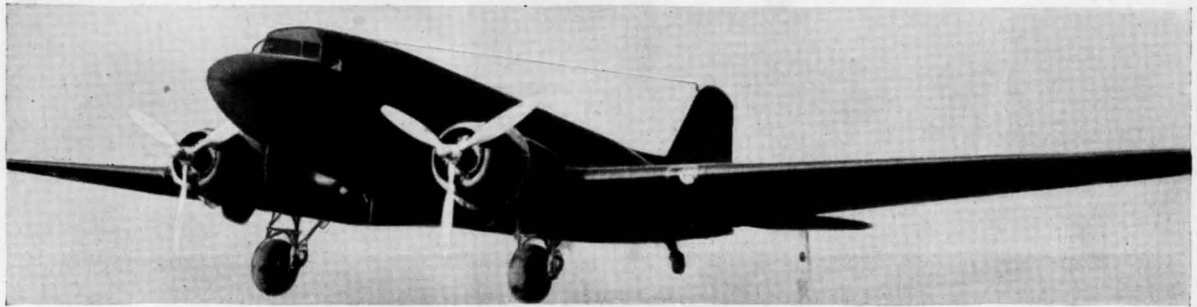
**IL-2 STORMOVIK GROUND ATTACK**

Crew.....	2.	Range.....	460 miles.
Span.....	47 feet, 9 inches.	Service ceiling.....	26,000 feet.
Length.....	38 feet, 1 inch.	Armament.....	2 7.62-mm.
Wing area.....	415 square feet.		2 20-mm.
Maximum speed at altitude.....	250 m. p. h./7,000 feet.		1 12.7-mm.

Figure 34.

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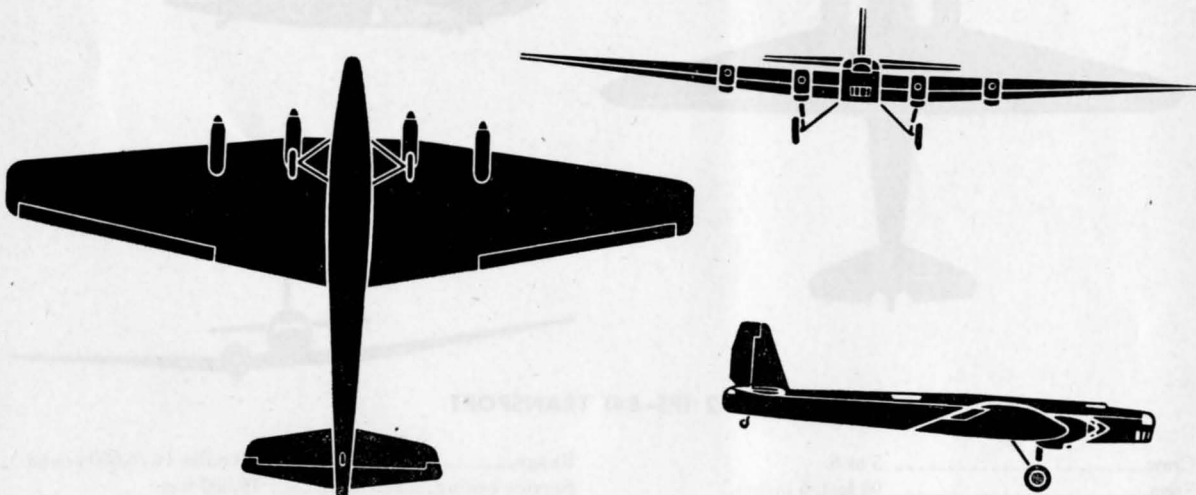
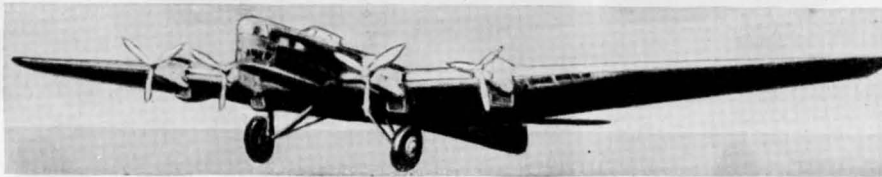
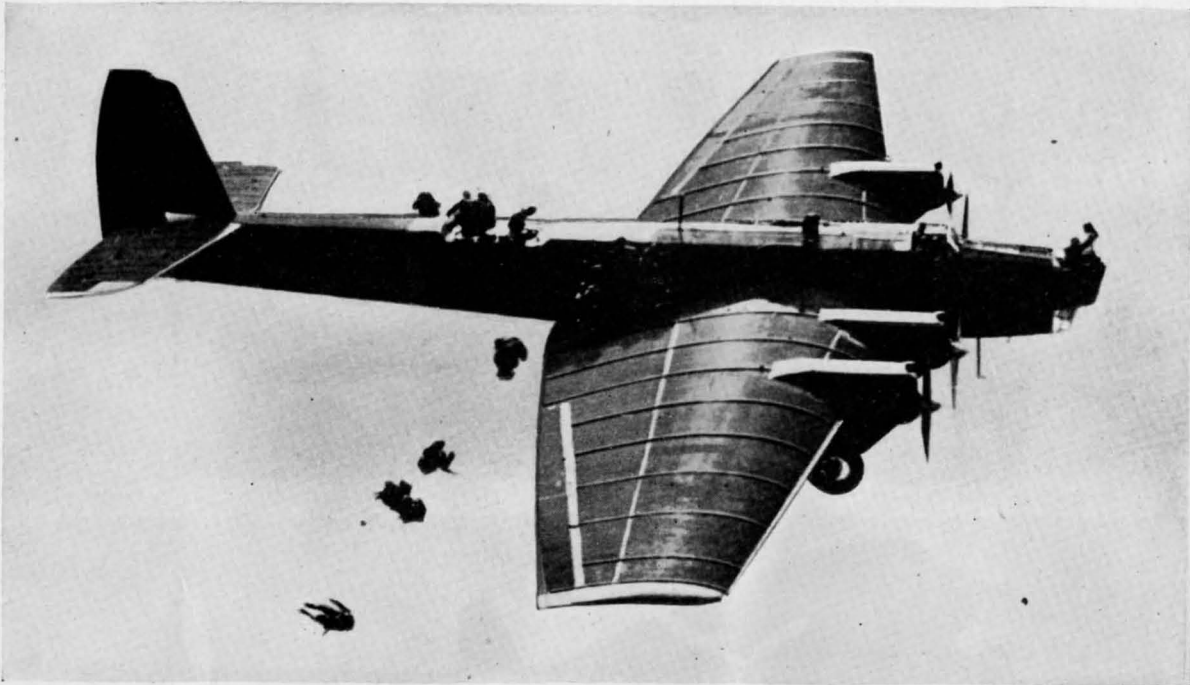
**RESTRICTED**  
CONFIDENTIAL**LI-2 (PS-84) TRANSPORT**

Crew.....	5 or 6.	Range.....	310 miles (w/6,600 pounds).
Span.....	94 feet, 6 inches.	Service ceiling.....	19,000 feet.
Length.....	63 feet.	Armament.....	1 12.7-mm.
Wing area.....	987 square feet.		2 7.62-mm.
Maximum speed at altitude.....	180 m. p. h./10,000 feet.		

*Figure 35.***RESTRICTED**  
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**TB-3 TRANSPORT**

Crew-----	8.	Maximum speed at altitude-----	160 m. p. h./15,800 feet.
Span-----	129 feet, 7 inches.	Range-----	1,430 miles.
Length-----	80 feet.	Service ceiling-----	25,200 feet.
Wing area-----	2,080 square feet.	Armament-----	4 7.62-mm.

Figure 36.

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**PO-2 (U-2) PRIMARY TRAINER**

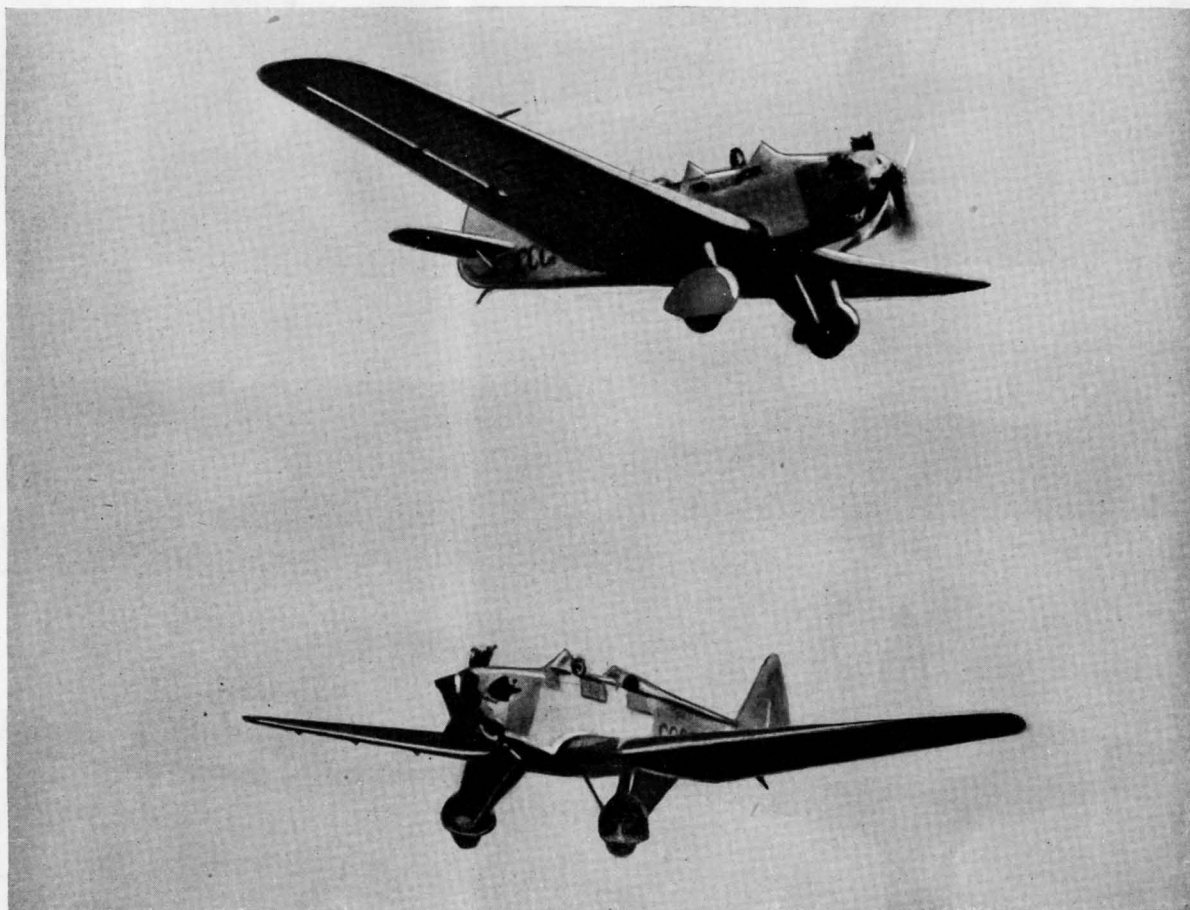
Crew..... 2.  
 Span.....  
 Length.....  
 Wing area.....

Maximum speed at altitude..... 94 m. p. h./sea level.  
 Range..... 310 miles.  
 Service ceiling..... 12,500 feet.  
 Armament..... 1 7.62-mm.

Figure 38.

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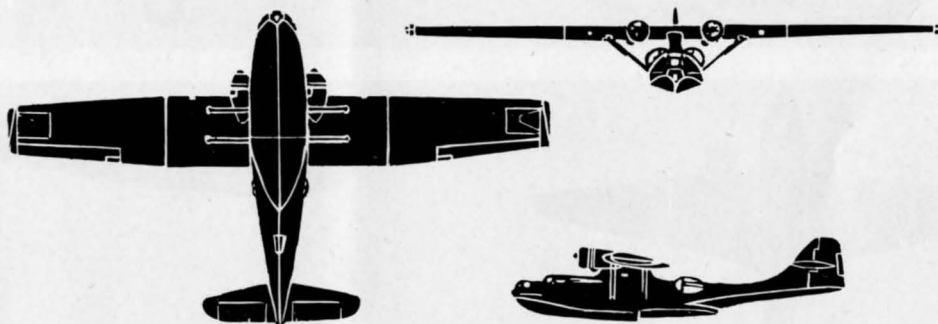
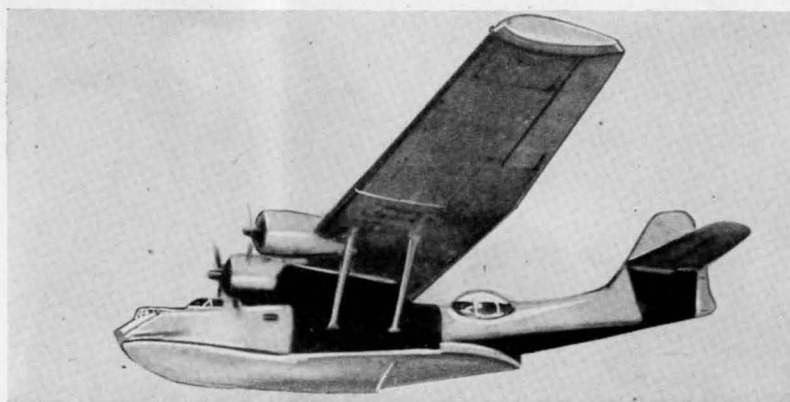
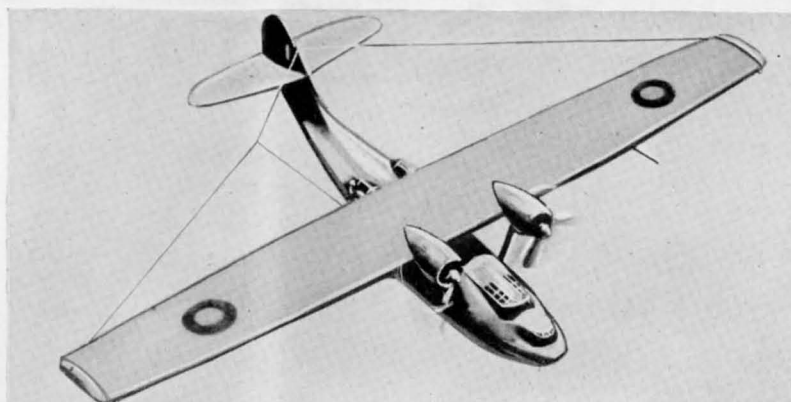


**UT-2 PRIMARY TRAINER**

Crew.....	2.	Maximum speed at altitude.....	130 m. p. h./sea level.
Span.....	34 feet, 5 inches.	Range.....	360 miles.
Length.....	23 feet, 5 inches.	Service ceiling.....	15,500 feet.
Wing area.....	184 square feet.	Armament.....	

*Figure 39.*



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**CONFIDENTIAL****GST (U. S. "CATALINA") PATROL AND RECONNAISSANCE**

Crew..... 7 to 9.  
 Span..... 104 feet.  
 Length..... 65 feet, 1 inch.  
 Wing area..... 1,400 square feet.

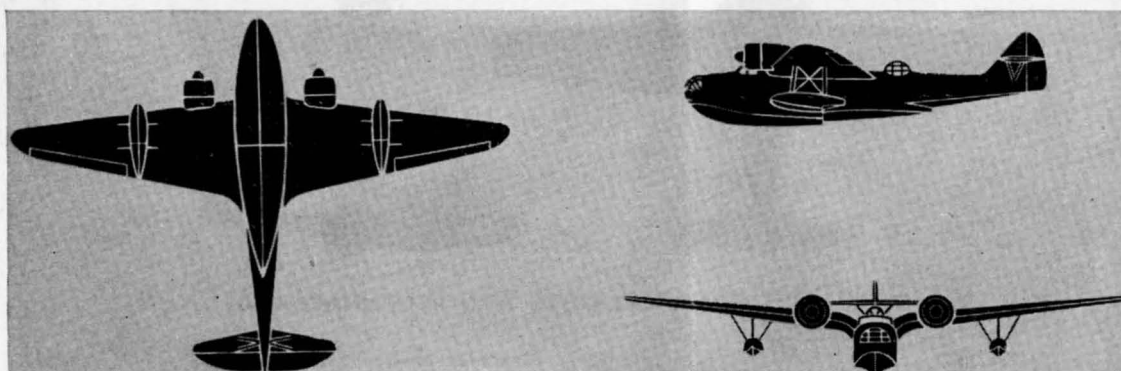
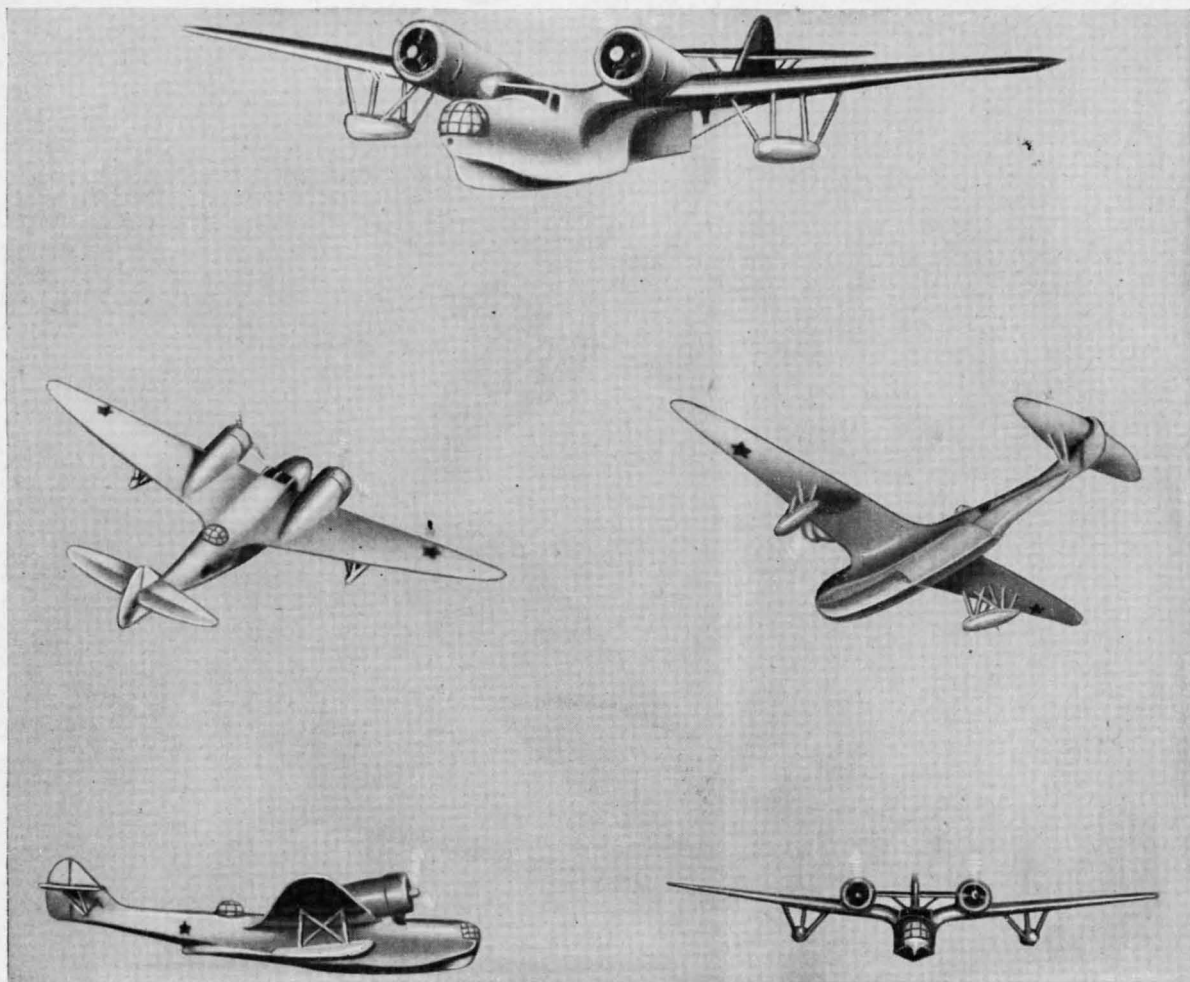
Maximum speed at altitude..... 175 m. p. h./9,000 feet.  
 Range..... 2,900 miles.  
 Service ceiling..... 23,000 feet.  
 Armament..... 4 to 6 7.62-mm.

Figure 41

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30 Jul 46

**MDR-6 PATROL AND RECONNAISSANCE**

Crew.....	5 to 7.	Maximum speed at altitude.....	220 m. p. h./10,000 feet.
Span.....	66 feet.	Range.....	1,000 miles.
Length.....	49 feet, 3 inches.	Service ceiling.....	28,500 feet.
Wing area.....	700 square feet.	Armament.....	4 7.62-mm.

Figure 42.

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## FIGHTERS

YAK-1.....	Standard.....	1xM-105P.....	6,030.....	6,230.....	1 32' 10'' 27' 11''	188.....	90.....	348 at 16,400'	500 <sup>1</sup> .....	1.5 min./3,280'.....	33,000.....	1x20-mm. Schvak..... 2x7.62-mm. Shkas.....	120..... 750.....	Engine..... Synchronized.....	Flaps. 4 self-sealing tanks. May have 2x12.7 mm. BS MGs and 6xRS 82 rocket projectiles. Oxygen equipment. Armor protection for pilot. Flaps 4 self-sealing tanks. Oxygen equipment. 4 self-sealing wing tanks. Development of YAK-1; used as advanced trainer. Maximum range of YAK-9d and YAK-9dt is 870 m. Alternate armament 1x37-mm. plus 1x12.7-mm. development of YAK-1 1x12.7-mm. development of YAK-1 4 self-sealing tanks; 484 lb. bomb can be carried under wings. Oxygen equipment. 6xRS82 rocket projectiles may be carried. Superseded by LAGG-5; 5 self-sealing wing tanks; may have 2x22-gallon belly tanks; 6xRS82 rocket projectiles may be carried. Operational middle 1943. 5 self-sealing wing tanks. Maximum speed with M-82 FNW 382 m.p.h. at 16,400 feet. Superseded LA-5 in late 1944.	
YAK-1B.....	Experimental.....	1xM-105PF.....	5,950.....		1 32' 10'' 27' 11''	188.....	90.....	355 at 13,100'	286 470 <sup>1</sup> .....	5 min./15,400'.....	34,500.....	1x20-mm. Schvak..... 1x12.7-mm. BS.....	120..... 200.....	Engine..... Synchronized.....		
YAK-7B.....	Obsolete.....	1xM-105PF.....	6,700.....		1 32' 10'' 27' 11''	188.....	90.....	348 at 13,100'	465 <sup>1</sup> .....		30,200.....	1x20-mm. Schvak..... 2x12.7-mm. BS.....	120..... 175.....	Engine..... Synchronized.....		4x55 lb..... 880 lb. maximum.....
YAK-9d, t, dt.....	Standard.....	1xM-105PF.....	6,200-6,800.....		1 32' 10'' 27' 11''	188.....	92½-147½.....	348 at 13,100'	465 for YAK-9t <sup>1</sup> .....	5.5-6.5 min./16,400'.....	30,000-32,000.....	1x20-mm. Schvak..... 1x12.7-mm. BS.....	120..... 220.....	Engine..... Synchronized.....		
YAK-3.....	do.....	1xM-105PF.....	5,850.....		1 30' 2'' 27' 9''	172.....		365 at 13,100'	465 <sup>1</sup> .....	4 min./16,400'.....	35,000.....	1x20-mm. Schvak..... 2x12.7-mm. BS.....	200..... 150.....	Engine..... Synchronized.....		
MIG-3.....	Obsolete.....	1xAM-35A.....	6,850.....	7,300.....	1 33' 8'' 26' 10''	189.5.....	122.....	385 at 23,000'	520 at 342 m. p. h.....	5.5 min./16,400'.....	39,400.....	1x12.7-mm. BS..... 2x7.62-mm. Shkas.....	300..... 750.....	Synchronized..... do.....		
LAGG-3.....	do.....	1xM-105P.....	7,050.....		1 32' 1'' 29' 2''	188.5.....	106-1150.....	365 at 16,400'	500.....	7 min./16,400'.....	29,500.....	1x20-mm. Schvak..... or 1 x 23-mm. WJA..... Plus 1 x 12.7 mm. BS.....	120..... 80..... 220.....	Engine..... do..... Synchronized.....		} 2x220 plus 2x22 lb.....
LA-5.....	do.....	1xM-82F or 1xM-82 FNW.....	7,450.....		1 32' 2'' 26' 6''	188.5.....	117.....	372 at 20,650'	740 <sup>1</sup> .....	5.2 min./16,400'.....	36,000.....	2x20-mm. Schvak.....	200.....			
LA-7.....	Standard.....	1xM-82 FNW.....	6,800.....		1 32' 2'' 26' 6''	188.5.....	117.....	405 <sup>1</sup> at 16,400'	560-620 <sup>1</sup> .....		37,000.....	2x20-mm. Schvak.....	200.....	Above and behind engine, synchron.....		

## BOMBERS

[illegible]

## GROUND ATTACK

IL-2.....	Obsolete.....	1xAM-38 or AM-38F...	12,250	2	47' 9"	38' 1"	415	158	250 at 7,000'	460 <sup>1</sup> .....	3.5 min./7,000'.....	26,000	2x7.62-mm. Sbkas..... 2x20-mm. Schvak..... 1x12.7-mm.....	750 200 210	Fixed, forward..... do..... Free.....	880 lb.....	3 self-sealing tanks. Drop tank may be carried. Radiators protected. Some have 2x37-mm. guns in place of 20-mm. (80 rounds per gun) or 2x23-mm.
IL-10.....	Standard.....	1xM-42 or AM-38.....		2	48' 2"	39'	420	162	280 at 7,000'				2x20-mm. or 23-mm..... 2x12.7-mm. or 2x7.62..... 1x20-mm. or 23-mm.....		Fixed, forward..... do..... Dorsal turret.....	2,200 lb.....	Development of IL-2.

## RECONNAISSANCE AND ARTILLERY OBSERVATION

[illegible]

ER-4.....	do.....	2xM-30 (Diesel).....			5	1 69'	1 48'			292 at 13,100' 1.		3,000/4,400 lb. 1.			1x12.7-mm.....	500		4,400 lb.....	Development of ER-2.
PE-8 (formerly TB-7).	Obsolete.....	4xAM-35 (Diesel).....	66,000	70,500	11	129' 6''	76' 5''	2,070	3,430	240 at 19,700' ..		2,500; 1,250/8,800 lb.	21 min./24,000' .....	29,000	2x12.7-mm.....	500			
															1x12.7-mm.....	500			
															2x7.62-mm Shkas.....	650	Nose.....	9,900 lb. 1.....	L/R Bomber. Developed from TB-6.
															1x20-mm. Schvak.....	200	Dorsal turret.....		Some have M-82 air-cooled radial engines. Fluid de-icing propeller.
															2x12.7-mm. BS.....	200	Inner engine nacelle.....		Leakproof and explosive-proof tanks. 2 bomb carriers under each wing. Largest bomb 4,400 lb.
															1x20-mm. Schvak.....	200	Tail.....		Oxygen equipment.
PE-2.....	Standard.....	2xM-105R.....	16,700	18,300	3	56' 5''	41' 6''	436	330	330 at 16,400' ..		930; 620/2,200 lb.....	10 min./16,400' .....	29,000	1x12.7-mm.....	150	Fixed forward.....	1,320 normal 2,200 lb. 1	May have 2xM-105PF engines.
															1x12.7-mm.....	200	Flexible dorsal.....		Dive bomber.
															1x7.62-mm.....	500	Fixed forward.....		
															1x7.62-mm.....	750	Flexible ventral.....		
															1x7.62-mm.....	(?)	Flexible lateral.....		
LI-2 (formerly PS-34).	Obsolete.....	2xM-62 IR.....	24,200		5-6	94' 6''	63'	987	684	180 at 10,000' ..		310/6,600 lb.....	18 min./16,000' .....	19,000	1x12.7-mm.....	100	Dorsal turret.....	2,200 to 6,600 lb. 1...	Douglas DC-3 built under license.
TB-3 (formerly ANT-4).	do.....	See transport.....										1,500/2,600 lb.			3x7.62-mm.....	950			

GROUND ATTACK

IL-2.....	Obsolete.....	1xAM-38 or AM-38F.....	12,250		2	47' 9''	38' 1''	415	158	250 at 7,000' ..		460 1.....	3.5 min./7,000' .....	26,000	2x7.62-mm. Shkas.....	750	Fixed, forward.....	880 lb.....	3 self-sealing tanks. Drop tank may be carried. Radiators protected. Some have 2x37-mm. guns in place of 20-mm. (80 rounds per gun) or 2x23-mm.
															2x20-mm. Schvak.....	200	do.....		
															1x12.7-mm.....	210	Free.....		
IL-10.....	Standard.....	1xM-42 or AM-38.....			2	1 48' 2''	1 39'	1 420	162	280 at 7,000' ..					2x20-mm. or 23-mm.....		Fixed, forward.....	2,200 lb.....	Development of IL-2.
															2x12.7-mm. or 2x7.62.....		do.....		
															1x20-mm. or 23-mm.....		Dorsal turret.....		

RECONNAISSANCE AND ARTILLERY OBSERVATION

IL-2.....		See ground attack.....																	
PE-2.....		See bombers.....																	
TU-2.....		do.....																	
YAK-7.....		See fighters.....																	
YAK-9.....		do.....																	

TRANSPORTS

LI-2 (formerly PS-84).		See bombers. As a transport 28 passengers or 15 to 16 paratroopers with full equipment may be carried.																	
PO-2 (U-2).....		See trainers. As many as 8 men may be carried in containers under lower wing.																	
R-5 (biplane)...	Obsolete.....	1xM-34N.....	7,060	7,730	2	50' 8''	31' 10''	457	155	170 at 11,500' ..		620 1.....		26,200	1x7.62-mm.....	600			Formerly used also as trainer and for communications.
TB-3 (ANT 14) ..	Standard.....	4xAM-34RN.....	41,300	46,500	8	129' 7''	80'	2,080	1,760	160 at 15,800' ..		1,430.....	20 min./16,400' .....	25,200	1x7.62-mm.....	800			Used as bomber early in war. 2 tanks may be fitted to increase capacity to 2,100 gals. Normal bomb load was 4,400 lb. A truck or light tank may be carried under fuselage. 34 paratroopers, equipped, or 41 men can be carried.
															2x7.62-mm. Shkas.....	2,000			
															1x7.62-mm. Shkas.....	3,000			
															1x7.62-mm. Shkas.....	1,000			
SHCHE-2.....	do.....	2xM-11 D.....			2	1 72'	1 51'			92-95 at S. L.....		360 1.....							Can carry 14 men or 9 stretcher cases.
YAK-6.....	do.....	2xM-11 E.....	3,200		2 to 3	46'	34'		85	135 at S. L.....		600.....		16,400	1x12.7-mm.....				Useful load about 1,100 lb., or 6 men.
															1x7.62-mm.....				

TRAINERS

PO-2 (U-2).....	Standard.....	1xM-11, or M-11D or M-11E.....			2					94 at S. L.....		310.....	10 min./5,000' .....	12,500	1x7.62-mm. (optional) ..				Primary trainer.
UT-2.....	do.....	1xM-11D or M-11C.....			2	34' 5''	23' 5''	184	44	130 at S. L.....		360.....		15,500					Do.
YAK-7b.....	do.....	See fighters. Used as advanced trainer.																	

NAVAL AIRCRAFT

MBR-2.....	Obsolete.....	1xAM-34-MB.....	11,700		3 to 4	1 64'	1 51'		220	165 at 6,600' ..	124	700 1.....	12 min./13,000' .....	20,000	2 or 3x7.62-mm. Shkas...	1,000		1,100 lb.....	Flying boat. Sea patrol and reconnaissance. Self-sealing tanks. 2 in wing and 2 in hull.
MDR-6.....	Standard.....	2xM-62.....	15,000		5 to 7	66'	49' 3''	700	1 440	220 at 1 10,000'		1,000.....	6.5 min./10,000' .....	28,500	2x7.62-mm.....		Front Turret.....		Flying boat for sea patrol and reconnaissance.
GST.....	do.....	2xM-62.....	25,000		7 to 9	104'	65' 1''	1,400	1,460	175 at 9,000' ..		2,900 1.....	16 min./9,000' .....	23,000	2x7.62-mm.....		Dorsal Turret.....	3,800 (?)	Flying boat for sea patrol and reconnaissance. American Catalina built under license.
KOR-1.....	Obsolete.....	1xM-25.....	7,000		2	1 35'	1 28'	1 320		170 at 16,500' ..		630.....	7.5 min./10,000' .....	26,500	2x7.62-mm.....				Ship-borne float-plane.

1 Maximum.  
2 Estimated.

Figure 43.—Characteristics and performance of aircraft.



RESTRICTED

Name	Type	Year	Basic type	Bore (inches)	Stroke (inches)	Swept volume (cubic inches)	Compression ratio	Reduction gear ratio	Supercharger	Fuel octane	Performance			Dry weight (pounds)	Power weight ratio (pounds per horsepower)	Dimensions				Fuel consumption (pounds per horsepower per hour)	Oil consumption (pounds per horsepower per hour)
											Take-off	Rated	Cruising			Frontal area (square feet)	Length (inches)	Height (inches)	Diameter (width) (inches)		
M-11G <sup>1</sup>	5-cylinder radial	1931-42	Russian	4.91	5.5	524.8	5:1	None	None	59	110 hp., 1,660 r. p. m.	100 hp., 1,590 r. p. m.	90 hp., 1,540 r. p. m.	352	3.1	9.79	35.37		42.24	0.55	0.044
M-25 <sup>1</sup>	9-cylinder radial	1934-36	Wright Cyclone	6.11	6.85	1818.5	6.4:1	None	Single-speed 8.31:1	87	635 hp., 1,950 r. p. m.	700 hp., 1,950 r. p. m., 6,600 ft.	570 hp., 1,885 r. p. m.	957	1.51	15.71	43.23		53.64	0.572-0.66	.0264
M-30 <sup>1</sup>	12-cylinder liquid-cooled V Diesel	1940	M-40F			{ 15.97 3801.8 }			Turbo-supercharger	( <sup>2</sup> )											
M-34	12-cylinder liquid-cooled V	1934-39	BMW-VI	6.28	7.46	2794.9	6:1	None	None	73	800 hp., 1,800 r. p. m.	750 hp., 1,760 r. p. m.	675 hp., 1,700 r. p. m.	1,340	1.675		78.01	44.89	33.79	.484	.044
M-34R	12-cylinder liquid-cooled V	1935-39	M-34	6.28	7.46	2794.9	6:1	1.7:1	None	73	825 hp., 1,850 r. p. m.	750 hp., 1,790 r. p. m.	675 hp., 1,730 r. p. m.	1,520	1.85					.484	.044
M-34 RNA	12-cylinder liquid-cooled V	1935-39	M-34	6.28	7.46	2794.9	6:1	1.7:1	10.8:1	87	820 hp., 1,850 r. p. m.	750 hp., 1,850 r. p. m., 11,500 ft.	675 hp., 1,760 r. p. m.	1,645	2		88.73	45.98	33.79	.561-.583	.044
M-40F	12-cylinder liquid-cooled V Diesel	1941	M-40	7.07	7.86	3804.2	13.5:1	1.43:1	4-Turbo-superchargers 2-two-stage	( <sup>2</sup> )	1,500 hp., 1,950 r. p. m.	1,250 hp., 1,950 r. p. m., 19,700 ft.		2,640	1.76		76.6	49.12	43.23	.34-.44	.0264
M-42	18-cylinder two-row radial	1944									2,000-2,200 hp.										
M-62 <sup>1</sup>	9-cylinder radial	1939-41	{ Wright Cyclone }	6.11	6.9	1818.5	6.4:1	none	2-speed 7.14:1/10:1	90-92	1,000 hp., 2,200 r. p. m.	{ 800 hp., 2,100 r. p. m., 13,750 ft. }	765 hp., 2,030 r. p. m.	1,130	1.23	15.93	43.62		54.03	.57-.66	.0264
M-62 <sup>1</sup> IR	9-cylinder radial	1940-44	M-62	6.11	6.9	1818.5	6.4:1	1.45:1	Single-speed 7:1	90-92	975 hp., 2,200 r. p. m.	840 hp., 2,100 r. p. m., 4,900 ft.	738 hp., 2,030 r. p. m., 3,940 ft.	1,190	1.21	15.93	47.94		54.03	.57-.705	.0264
M-63	9-cylinder radial	1939-41	M-62	6.11	6.9	1818.5	7.2:1	none	2-speed 7.14:1/10:1	94	1,100 hp., 2,300 r. p. m.	1,000 hp., 2,200 r. p. m., 5,850 ft.	960 hp., 2,100 r. p. m., 4,900 ft.	1,130	1.035	15.93	43.62		54.03	.57-.69	.0264
M-65	9-cylinder radial	( <sup>3</sup> )	M-63						2-speed		1,800 hp.										
M-71	18-cylinder radial	( <sup>4</sup> )		5.73	6.4	3032.9															
M-82 <sup>1</sup>	14-cylinder radial	1941	{ Wright Cyclone }	6.11	6.09	2514.2	7:1	1.45:1	2-speed 7.14:1/10:1	95-100	1,700 hp., 2,400 r. p. m.	{ 1,540 hp., 2,400 r. p. m., 6,700 ft. }		1,950	1.15	13.14	77.81		49.51	.715	
M-85	14-cylinder radial	1936-38	G. R.-14K	5.73	6.48	2358.6	5.5:1	1.5:1	Single-speed 8.5:1	87	765 hp., 2,000 r. p. m.	800 hp., 2,400 r. p. m., 12,600 ft.	720 hp., 2,320 r. p. m., 12,600 ft.	1,320	1.725	14.42	58.04		51.32	.66	.042
M-87A and B	14-cylinder radial	1937-40	M-85	5.73	6.48	2358.6	6.1:1	1.5:1	Single-speed 8.94:1	90-92	950 hp., 2,250 r. p. m.	950 hp., 2,350 r. p. m., 15,400 ft.	955 hp., 2,280 r. p. m., 15,400 ft.	1,360	1.43	14.04	59.97		50.81	.583-.65	.042
M-88B <sup>1</sup>	14-cylinder radial	1940-44	M-87	5.73	6.48	2358.6	6.1:1	1.5:1	2-speed 7.57:1/9.6:1	90-92	1,100 hp., 2,300 r. p. m.	1,100 hp., 2,375 r. p. m., 13,100 ft.	990 hp., 2,300 r. p. m., 13,100 ft.	1,500	1.36	14.2	68.1		50.81	.585-.705	.042
M-89	14-cylinder radial	1943	M-88	5.73	6.88	2502			2-speed	95	1,300 hp., 2,400 r. p. m.	1,240 hp., 2,400 r. p. m., 11,500 ft.								.7-.75 (take-off)	
M-100	12-cylinder liquid-cooled V	1935-38	H. S.-12Y	5.89	6.68	2196.9	6:1	1.5:1	Single-speed 10:1	80	665 hp., 2,050 r. p. m.	750 hp., 2,400 r. p. m., 14,100 ft.	660 hp., 2,320 r. p. m., 14,100 ft.	1,070	1.43	16.79	67.71	37.74	30.02	.55-.67	.0264
M-103 <sup>1</sup>	12-cylinder liquid-cooled V	1938-40	M-100	5.89	6.68	2196.9	6.6:1	1.5:1	Single-speed 11:1	92	850 hp., 2,050 r. p. m.	960 hp., 2,450 r. p. m., 13,100 ft.	865 hp., 2,350 r. p. m., 13,100 ft.	1,100	1.3		77.46	37.02	30.02	.55-.615	.0264
M-103A	12-cylinder liquid-cooled V	1938-40	M-100	5.89	6.68	2196.9	6.6:1	1.5:1	Single-speed 11:1	95	1,000 hp., 2,400 r. p. m.	960 hp., 2,450 r. p. m., 13,100 ft.	865 hp., 2,350 r. p. m., 13,100 ft.	1,100	1.1		77.46	37.02	30.02		
M-105, <sup>1</sup> P, PA and R	12-cylinder liquid-cooled V	1940	H. S.-12Y	5.81	6.68-6.77	2135.8	7:1	1.7:1 (P & PA) 1.5:1 (R)	2-speed 7.8:1/10:1	95	1,100 hp., 2,600 r. p. m.	1,050 hp., 2,700 r. p. m., 13,100 ft.	945 hp., 2,600 r. p. m., 13,100 ft.	1,260	1.14		79.66	37.13	30.53	.535-.64	.0264
M-105PF <sup>1</sup>	12-cylinder liquid-cooled V	1942	M-105	5.81	6.68-6.77	2135.8	7.1:1	1.7:1	2-speed 7.85:1/10:1	95	1,260 hp., 2,700 r. p. m.	1,180 hp., 2,700 r. p. m., 8,900 ft.		1,350	1.12		79.77	37.72	30.53		
M-105PD	12-cylinder liquid-cooled V	1942	M-105	5.81	6.68-6.77	2135.8	7.1:1	1.7:1	2-stage with hydraulic coupling	95	1,100 hp.	1,050 hp., 21,000 ft.									
M-106	12-cylinder liquid-cooled V	1942	M-105	5.81	6.68-6.77	2135.8	7.1:1		Single-stage 2-speed		1,350 hp.	1,225 hp., 13,000 ft.									
M-107	12-cylinder liquid-cooled V	1943	M-106	5.81	6.68-6.77	2135.8	6.7:1	1.7:1	2-speed 6.6:1/8.9:1	95	1,460 hp., 2,900 r. p. m.	1,230 hp., 2,750 r. p. m., 14,400 ft.									
M-107A	12-cylinder liquid-cooled V	1944	M-106	5.81	6.68-6.77	2135.8	7.7:1		2-speed	95	1,600 hp., 3,200 r. p. m.	1,500 hp., 14,750 ft.		1,540			82.92	40.87	31.83		
M-120	18-cylinder liquid-cooled V	( <sup>5</sup> )	M-105	5.81	6.68-6.77	3222.1			2-stage turbo		1,800 hp.	1,650 hp., 19,700 ft.		1,980							
M-300	36-cylinder 6-block liquid-cooled	( <sup>5</sup> )	M-100	5.89	6.68	6590.7		( <sup>5</sup> )			3,000 hp.										
AM-35A <sup>1</sup>	12-cylinder liquid-cooled V	1940-41	BMW-VI	6.28	7.46-7.73	2847.4	7:1	1.36:1	Single-speed 14.6:1	95	1,350 hp., 2,050 r. p. m.	1,200 hp., 2,050 r. p. m., 19,700 ft.	1,150 hp., 2,050 r. p. m., 23,000 ft.	1,820	1.34		89.99	42.44	34.38	.595-.79	.0264
AM-37	12-cylinder liquid-cooled V	1942	AM-35A	6.28	7.46-7.73	2843.7					1,400 hp., 2,150 r. p. m.	1,400 hp., 2,150 r. p. m., 19,700 ft.		1,870							
AM-38, 38A <sup>1</sup>	12-cylinder liquid-cooled V	1940-43	AM-35A	6.28	7.46-7.73	2843.7	6.8:1	1.36:1	Single-speed 11.05:1	95	1,600 hp., 2,150 r. p. m.	1,550 hp., 2,150 r. p. m., 6,550 ft.	1,410 hp., 2,150 r. p. m., 9,850 ft.	1,890	1.19		89.99	42.44	34.38	.595-.715	.0264
AM-38F <sup>1</sup>	12-cylinder liquid-cooled V	1943-44	AM-38	6.28	7.46-7.73	2843.7	6.8:1	1.36:1	Single-speed 11.05:1	95	1,700 hp., 2,350 r. p. m.	1,550 hp., 2,150 r. p. m., 6,550 ft.	1,410 hp., 2,150 r. p. m., 9,850 ft.	1,890	1.105		89.99	42.44	34.38	.595-.715	.0264
AM-39	12-cylinder liquid-cooled V	1942	AM-35A	6.28	7.46-7.73	2843.7			Single-speed												

<sup>1</sup> Installed in standard and obsolescent aircraft in operational units.

<sup>2</sup> Diesel oil or gasoline.

<sup>3</sup> Under development.

Figure 44.—Characteristics and performance of aircraft engines.

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#### 4. CHARACTERISTICS AND PERFORMANCE OF SOVIET AIRCRAFT

For characteristics and performance of Soviet aircraft, see fig. 43.

#### 5. AIRCRAFT ENGINES

Aircraft engine production in the Soviet Union has been based on four engines procured under licenses in the years 1930 to 1936, inclusive. They are the Wright Cyclone, the Gnome-Rhone 14K, the Hispano Suiza 12V, and the Bayerische Motoren Werke BMW-VI. A number of engines also were based on the Bristol Jupiter and Pratt and Whitney Wasp series. These basic types have been modified and developed by Soviet aeronautical engineers (figs. 44, 45, 46, 47, 48, 49, and 50).

In 1944 engine production was concentrated on the following types:

Air-cooled: M-88B, M-82, M-62IR, M-11.

Liquid-cooled: M-105PF, M-107, AM-38.

These engines usually are fitted with two-speed superchargers, providing a rated altitude of from 13,000 to 20,000 feet, except for the M-62IR and AM-38, which are designed for low-level operations and have single-speed superchargers. Some work has been done on a two-stage supercharger for the M-105PD engine. Except for its installation on the M-40F Diesel engine, the turbo-supercharger has not appeared in operational aircraft.

## Section II. WEAPONS AND AMMUNITION

### 1. MACHINE GUNS AND CANNON

The standard light and heavy aircraft machine guns and cannon in the Soviet air forces are the SHKAS 7.62-mm., the BEREZIN BS 12.7-mm., the SCHVAK 20-mm., the V-YA 23-mm., and the NS 37-mm. (figs. 51 and 52). These guns are of a high standard in regard to rate of fire, method of operation, and general reliability. Gun mounts, however, some of which are similar in design to those used during World War I, fall far below the standards of a modern air force.

**a. Reloading.** The gas-operated principle of reloading is used in all light and heavy machine guns. The 23-mm. cannon uses the gas unlocking and recoil reloading method utilized in Hispano weapons. The 37-mm. cannon is entirely recoil-operated.

**b. Types.** All Soviet guns, with the exception of the 37-mm. cannon, are made in several types. The 7.62-mm. and 12.7-mm. machine gun can be mounted either fixed or free. Fixed guns can be synchronized.

**c. Cocking.** There are various methods of cocking 7.62-mm. guns. Mechanical cocking by hand always is provided. In addition, the newer types of guns have pneumatic or hydraulic cocking.

**d. Feed systems.** Rounds for 7.62-mm. machine guns and 20-mm. cannons are contained in disintegrating belts and are fed into a feed cage incorporated in the gun which breaks up the belt and feeds the rounds into the breach. The same method was tried on 12.7-mm. machine guns, but was not adopted. Disintegrating belts on 12.7-mm. machine guns and 23-mm. cannons feed directly into the guns.

**e. Cannon installation.** The 20-mm. cannon is installed usually as a fixed gun. But in the PE-8, obsolescent four-engined bomber, there is a 20-mm. SCHVAK installed in the rear gun turret. The 23-mm. cannon always is fixed. Both guns can be mounted in the wing or engine.

### 2. AMMUNITION

**a. General.** The quality of Soviet aircraft ammunition is inferior to that of Soviet aircraft machine guns and cannon. Despite high muzzle velocity, 20-mm. and larger ammunition has poor armor penetration. The weight compares to that of the ammunition used by other first class air forces, except for the 20-mm. projectiles, which are lighter (fig. 53).

**b. Special ammunition for SHKAS 7.62-mm. machine guns.** AP/I round B-32 penetrates from 0.27 to 0.31 inch of cement at 656 feet and ignites combustibles behind the cement armor.

AP/Tracer round BV-46 penetrates 0.23 inch of armor plate at 656 feet and ignites combustibles behind the plate. It leaves a white trace for 2,297 feet.

Incendiary/Fragmentation round PS ignites fuel in tanks not protected by armor.

**c. Special ammunition for 12.7-mm. machine guns.** AP/I round B-22 penetrates 0.78 inch cement armor at 656 feet and ignites combustibles behind the cement armor.

AP/Phosphorous round BSF-46 penetrates 0.78 inch strong armor plate at 656 feet and ignites com-



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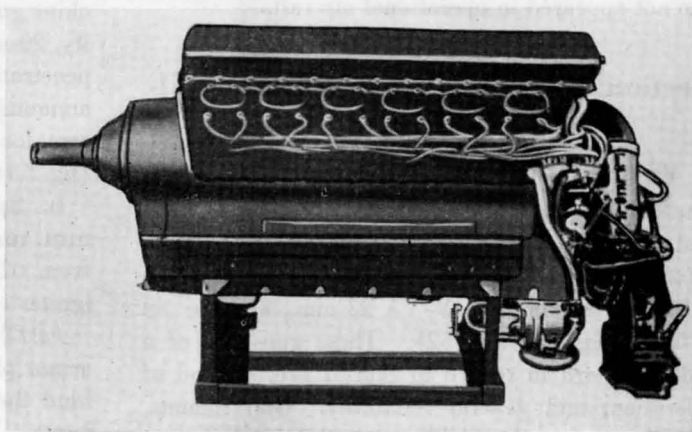
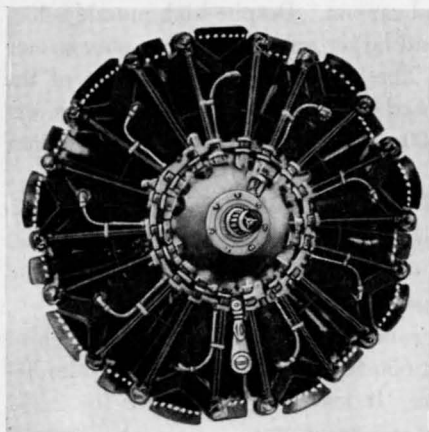
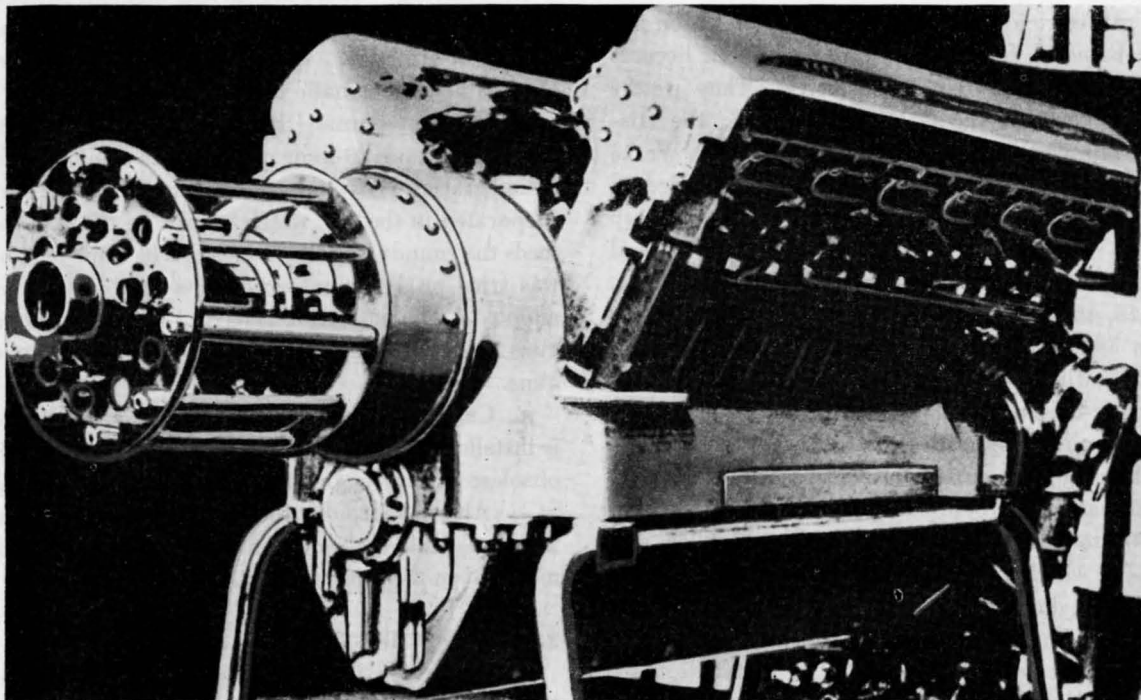


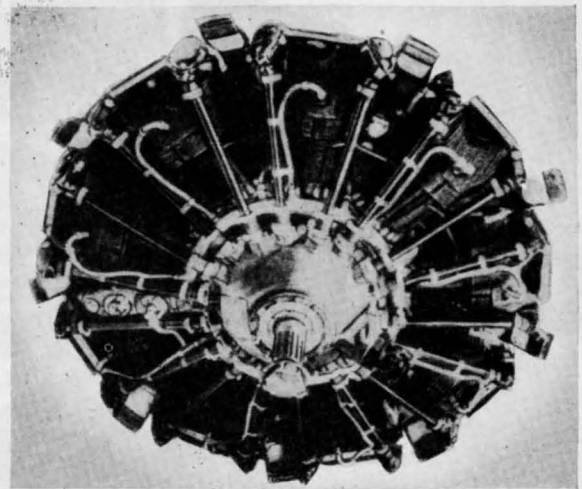
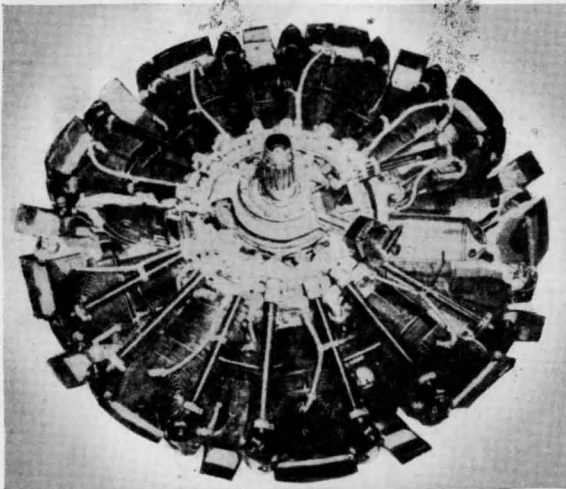
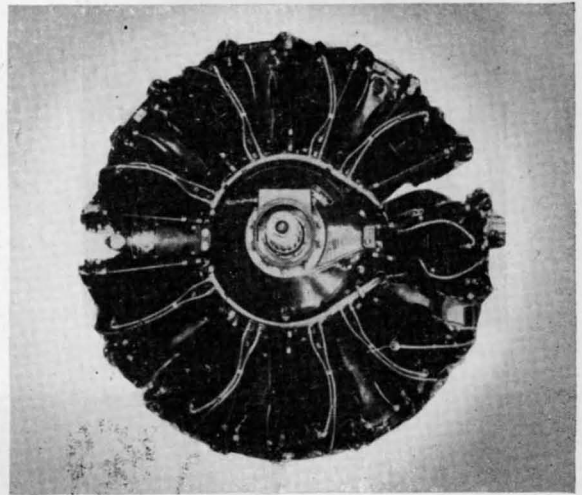
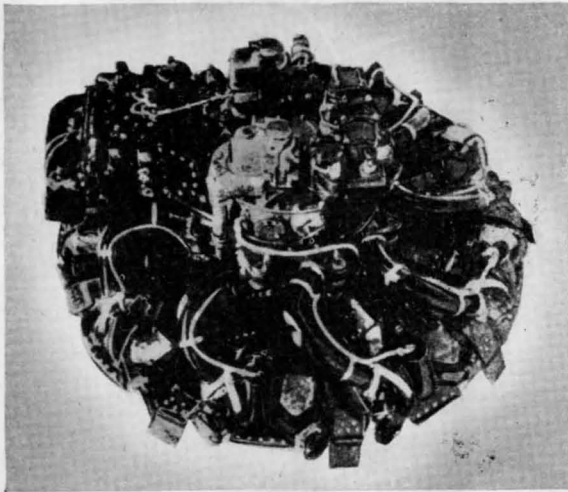
Figure 45.—Soviet aircraft engines M-34 (top), M-34 RNA (lower left), and M-25 (lower right).

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*Figure 46.—Typical Soviet radial designs.*

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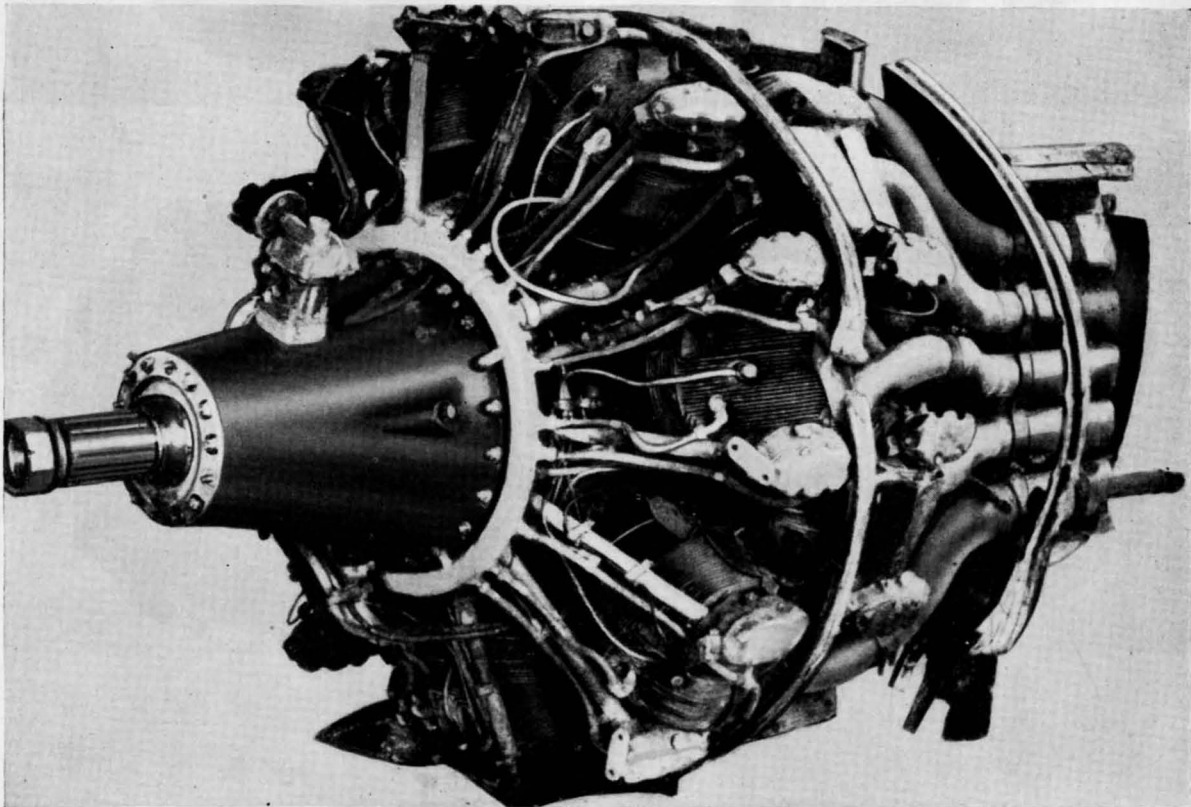
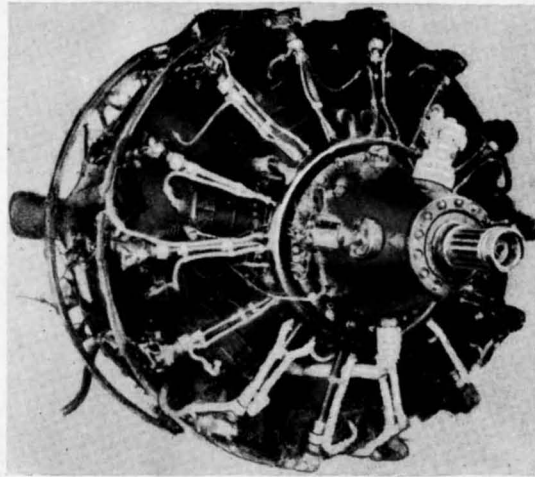
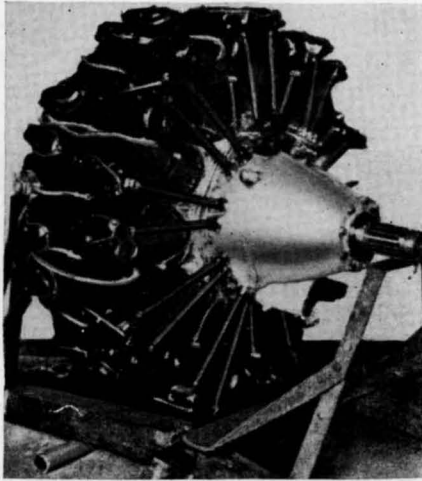


Figure 47.—Soviet aircraft engines M-71 (top left), M-82 (top right), and M-82 FNW (bottom).



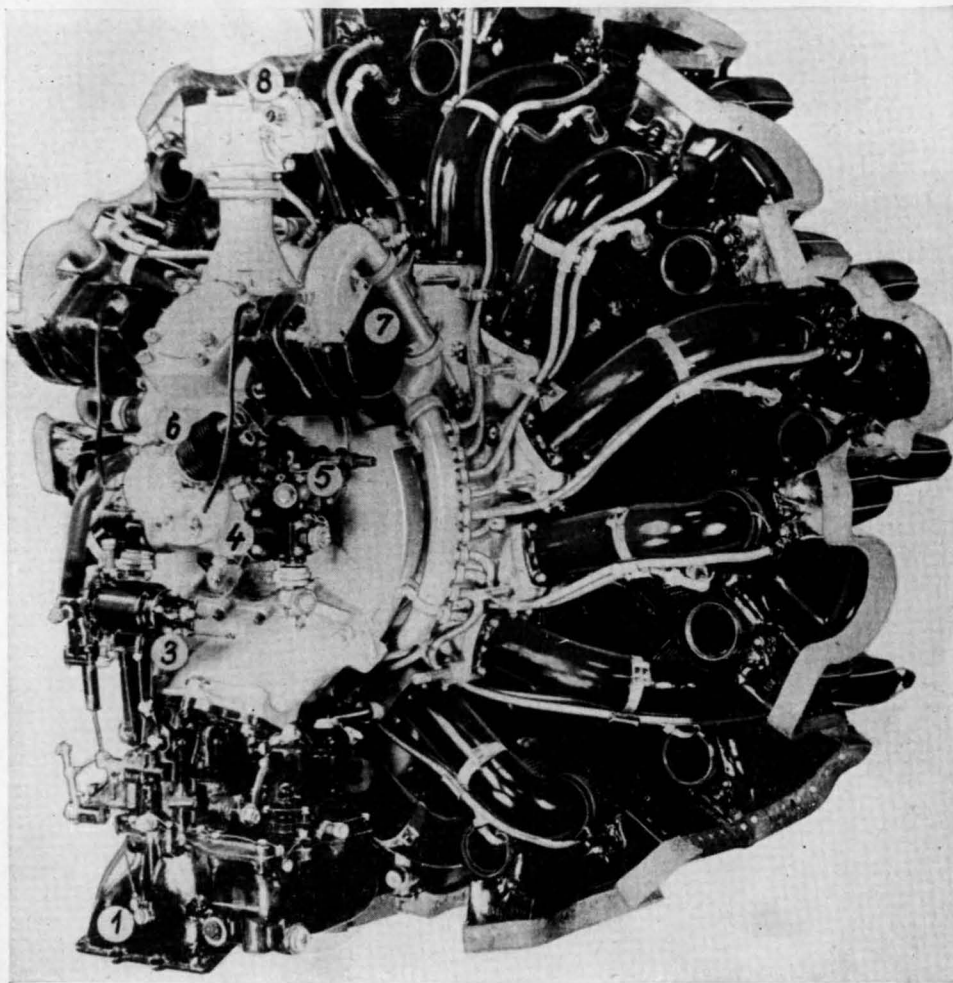
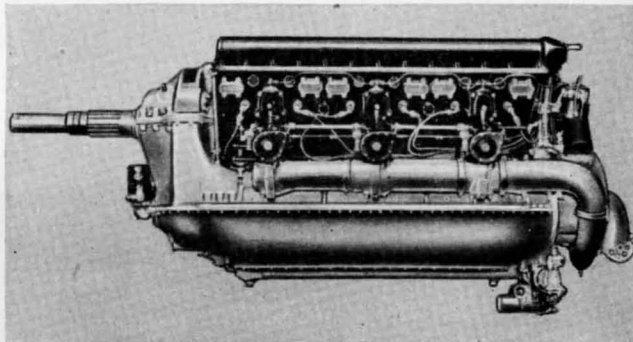
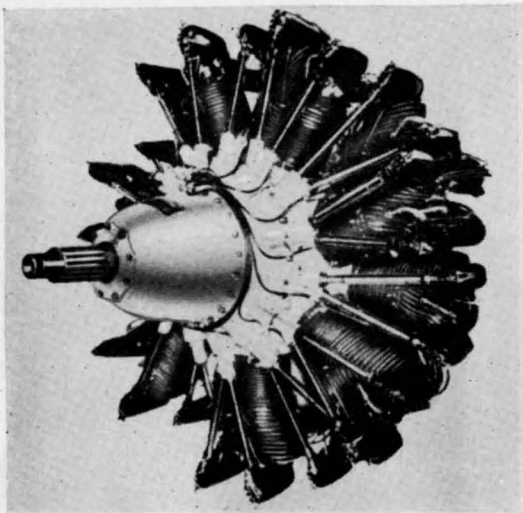


Figure 48.—Soviet aircraft engines M-85 (top left), M-100 (top right), and M 88B (bottom).

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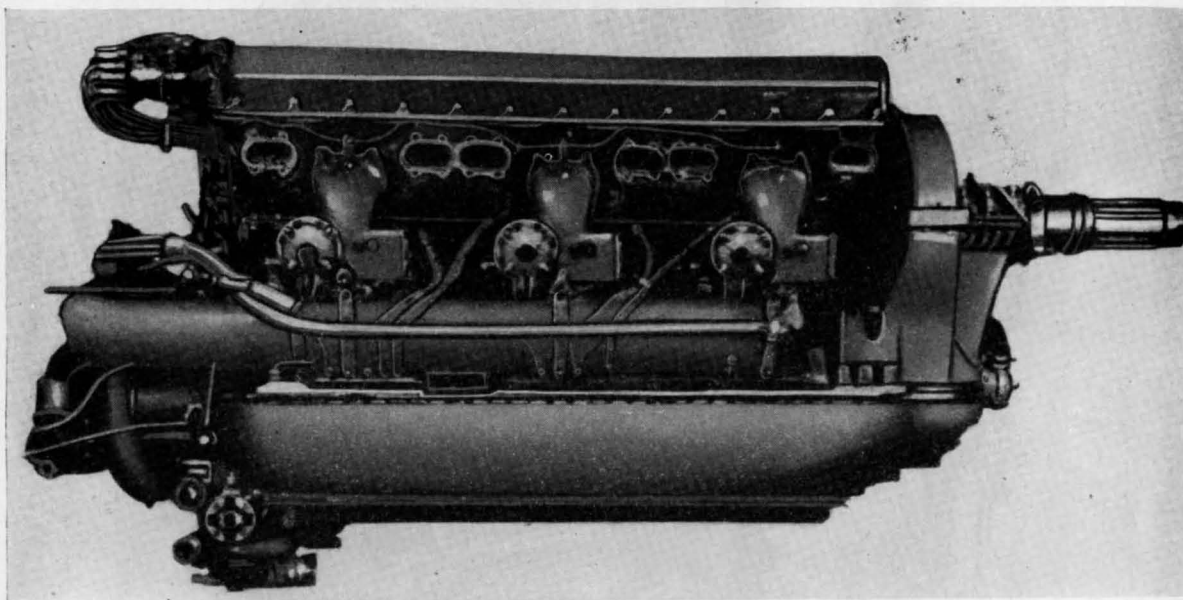
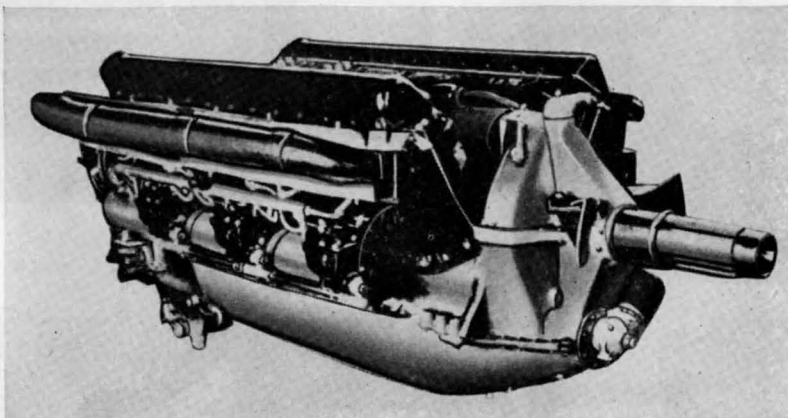


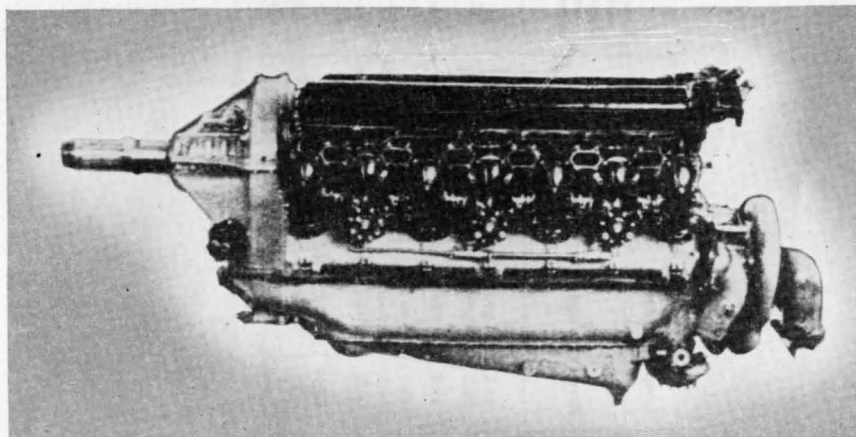
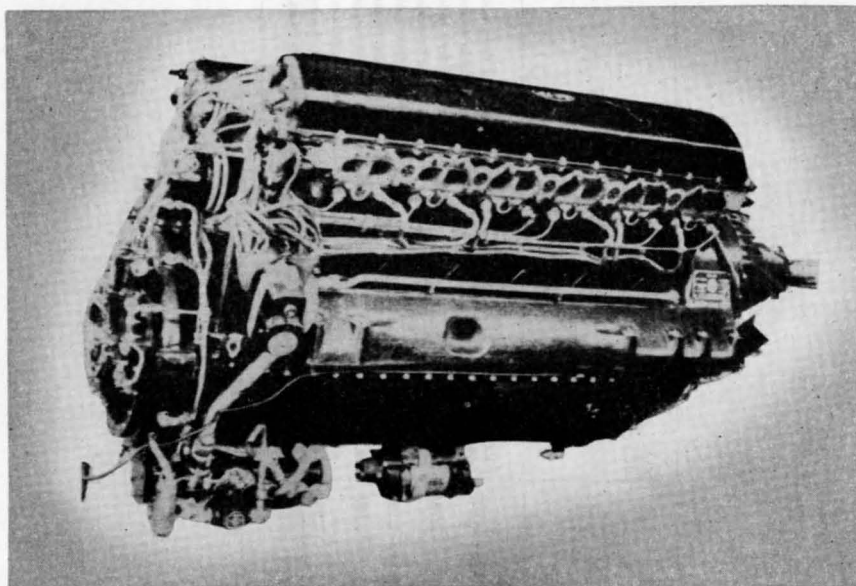
Figure 49.—M-105P (top) and M-105PF (bottom) aircraft engines.

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*Figure 50.—Typical Soviet liquid-cooled designs.*

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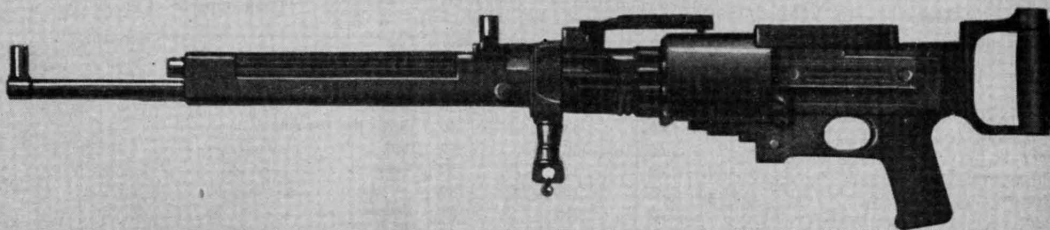
Designation	Caliber (mm.)	Weight (pounds)	Length (inches)		Type of operation	Rate of fire (rounds per minute)	Muzzle velocity (feet per second)	Ammunition		Remarks
			Barrel	Total				Number of rounds	Weight 100 rounds (pounds)	
Shkas.....	7.62	23.1	23.5	37.5	Gas.....	2,000	2,564-2,703	{500-750, belt.....}	7.48	{Fixed and free mounting; unsynchronized. Fixed; synchronized.
Berezin BS.....	12.7	23.6	29.2	44.9						
		56.1	39.6	52.9	.....do.....	700-800	2,746	250-350, belt.....	37.4	{Fixed and free mounting; unsynchronized. Fixed; synchronized.
Schvak.....	20	88								
		123.2	48.9	69.4	.....do.....	780-800	2,463-2,591	120-180, belt.....	49.06	{Fixed and free mounting; unsynchronized. Fixed; engine mounted.
V-YA.....	23	66.8	86.9	84.1						
		150.7	64.8	84.1	Recoil-operated with gas pressure unlocking.	370-500	2,965-3,008	80, belt.....	128.2	Fixed; unsynchronized; may be used as engine mounted cannon.
NS.....	37	363	90.39	133.6						
					Recoil.....	585-620 400	2,952	Belt with pneumatic drive.....		Fixed; unsynchronized; believed also used as engine mounted cannon.

<sup>1</sup> Latest types.

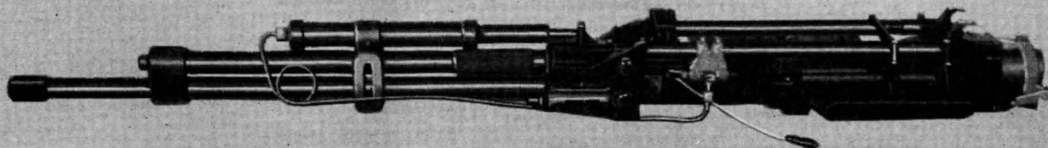
Figure 51.—Characteristics of aircraft machine guns and cannon.



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SHKAS 7.62-MM MACHINE GUN



BEREZIN BS 12.7-MM MACHINE GUN



SCHVAK 20-MM CANNON



V-YA 23-MM CANNON

Figure 52. Aircraft machine guns and cannon.

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Type	Caliber (mm.)	Weight of round	Weight of filler	Color of ogive	Color of band
		<i>Grains</i>	<i>Grains</i>		
Incendiary.....	7.62	152	49	Red tip, red ring.....	Red.
Tracer (day).....	7.62	144	46	Green.....	Do.
Tracer/AP.....	7.62	150	49	Violet tip, red ring.....	Do.
HE/incendiary.....	7.62	152	47	Red.....	Do.
Ball (without groove).....	7.62	149	49	None.....	Do.
Ball (with groove).....	7.62	149	49	do.....	None.
Ball.....	7.62	182	47	Yellow.....	Do.
AP.....	7.62	168	47	Black.....	Do.
Incendiary.....	12.7		262	Black tip, yellow ring.....	
AP/tracer/incendiary.....	12.7	700	262	Violet tip, red ring.....	
AP/incendiary.....	12.7	740	262	Black tip, red ring.....	
		<i>Ounces</i>	<i>Ounces</i>		
AP/incendiary.....	20	3.42	0.60-0.63	do.....	
AP/HE.....	20	3.42	0.60-0.63	None.....	
AP/incendiary.....	23	6.9	2.2	do.....	
AP/HE.....	23	6.99	2.2	do.....	
AP/tracer.....	37	24.86			
HE/incendiary.....	37	24.93			
HE/tracer.....	37	24.15			
AP/tracer.....	37	26.52			

Figure 53.—Characteristics of aircraft ammunition.

bustibles behind the armor. It also ignites combustibles not protected by armor.

AP/Tracer round BST penetrates 0.59 inch armor at 656 feet and ignites combustibles behind plate. It leaves a red tracer up to 3,280 feet.

HE round MDS-46 ignites combustibles not protected by armor plate and covers an area 15.7 inches in diameter with splinters.

**d. Special ammunition for SCHVAK 20-mm. cannon.** Fragmentation round OS produces a hole 15.7 inches in diameter in skin of aircraft and ignites combustibles.

AP/I round BS penetrates 0.98 inch armor plate at 1,312 feet and ignites combustibles behind armor plate.

### Section III. BOMBS

#### 1. TYPES OF BOMBS

**a. General.** Soviet bombs usually are colored gray, although parts of bombs are not painted (fig. 54). Printed on the bomb body are the caliber, type of fuse, type of filler, and kind of detonator. On the tail are found the year of delivery, the delivery number, and the factory number.

**b. High explosive.** Both welded and forged high explosive bombs are manufactured (figs. 55, 56, 57, and 58). The explosive filler generally comprises from 45 to 50 percent of the total bomb weight. Depending upon the size of the bomb and type of filler, up to 20 exploder pellets, each weigh-

Type	Ogive	Neck	Band
HE.....			
AP.....		Yellow-red	
Fragmentation.....	Green	Blue	
Chemical warfare gas:			
HE/harassing gas.....	Green		Green-blue.
Persistent gases B.....	Red		Green.
Nonpersistent gases B.....	Green		Do.
AP or fragmentation gas.....	Yellow	Yellow-blue	
Toxic smoke.....			Yellow-green.
Incendiary (electron).....	Yellow		Blue.
Flare.....	White		White.
Rocket.....		Blue	Black.
Practice.....	Red		White.

Figure 54.—Color of bomb markings.

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	Welded HE bombs					Forged HE Bombs		
	FAB-1000	FAB-500	FAB-250	FAB-100	FAB-50	FAB-250	FAB-100	FAB-50
Maximum diameter (inches).....	19.61	17.68	12.76	11	9.43	12.77	10.72	8.6
Thickness of walls of cylindrical portion (inches)....	0.51	0.35	0.23	0.54	0.35	0.43	0.35	0.31
Total length (inches).....	140.37	94.75	84.88	41.46	37.21	70.15	41.14	37.09
Filler weight (pounds).....	1,049.3	518	260.1	70.5	52.9	250.4	101.6	55.1
Percentage of total weight.....	46	46.3	47.5	31	48	48	47	41.5
Fuze (K-nose, H-tail).....	KH	KH	KH	KH	K	KH	K	K
Terminal velocity from 9,600 feet (feet per second)...	873	836	833	764	754			

Figure 55.—Characteristics of high explosive bombs—FAB.

Type	Fuze	Height of release (feet)	Penetration depth (feet)	Effect of blast (feet)	Size of crater (cubic yards)	Use
FAB-1000.....	APUV AV-1	3,280-1,312	34.4	183.7	483.9	Large important installations. Ships.
FAB-500.....	APUV AV-1	2,624-1,312	19.68	135.2	214.4	Important installations without special protection.
FAB-250.....	APUV AV-1	2,296-1,312	16.4	91.8	104.6	Industrial targets and heavy installations.
FAB-100.....	APUV AV-1	1,312	11.7	59	32.6	Difficult targets.
FAB-50.....	APUV AV-1	1,312	7.8	39.3	21.3	Village installations and tanks.

Figure 56.—Performance of high explosive bombs.—FAB.

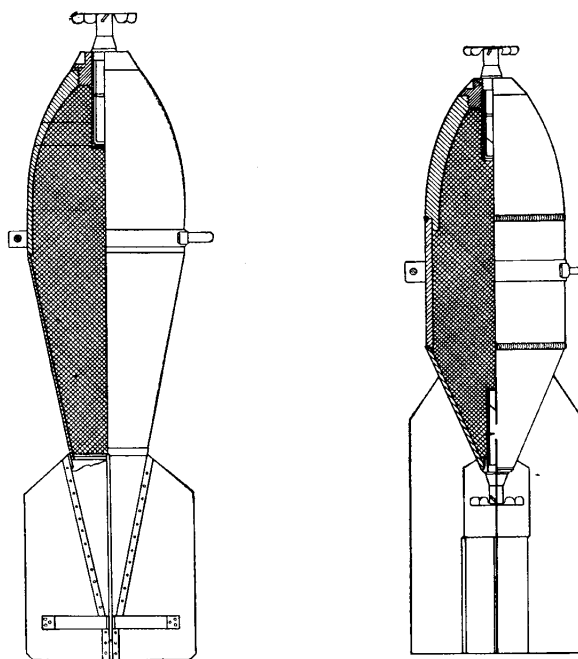


Figure 57.—High explosive bomb, FAB-50 (left) and FAB-100 (right).

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ing 2.99 ounces, can be inserted. Bombs up to 220 pounds are suspended for vertical and horizontal stowage by one lug. Larger bombs are suspended horizontally by two lugs. Nose fuzes are used on 110-pound and forged 220-pound bombs. All others are nose- and tail-fuzed. Types of fuzes include:

Time fuzes AGP and ADP.

Impact fuze AV-1 (with fixed delay action).

Variable delay fuze APUV (for large caliber, now obsolescent).

**c. Armor-piercing.** Armor-piercing heads are manufactured of cast iron and are screwed to the tail portion. The filler comprises from 16 to 25 percent of the total weight. Armor-piercing bombs are suspended horizontally by one or two lugs and are fuzed usually with the AM-1 impact fuze with delay action (figs. 59 and 60).

**d. Fragmentation.** There are approximately 20 different types of fragmentation bombs varying in weight from 5.5 to 110 pounds (figs. 61 and 62). The majority are modified artillery shells.

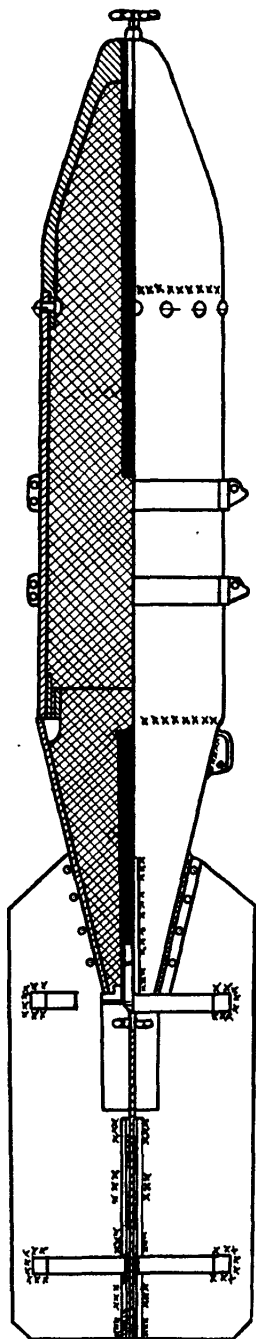


Figure 58.—High explosive bomb FAB-1000.

	BRAB-1000	BRAB-500	BRAB-220
Maximum diameter (inches).....	18.8	15.7	10.9
Total length (inches).....	120.8	93.7	66
Filler weight (pounds).....	457.2	233.6	83.7
Percentage of total weight.....	21.4	21	16
Total weight (pounds).....	2,127.4	1,104.5	524.6
Fuze.....	Tail	Tail	Tail

Figure 59.—Characteristics of armor-piercing bombs—BRAB.

Only four fragmentation bombs designed purely for aerial purposes are known, the 4.4-, 11-, 22-, and 33-pound bombs. These are made of cast iron. The filler normally comprises approximately 10 percent of the total weight. The 17.6, 22-, and 33-pound fragmentation bombs may be filled with gas. They then are designated AOKh-8, AOKh-10, and AOKh-15 (figs. 63 and 64).

Fragmentation bombs use impact fuzes AGM-1 (without delay), AGM-3, AM-4, AV-4, the time fuzes ADP and AGP, and the Universal variable delay fuze APUV. Nose fuzing is used almost exclusively.

**e. Incendiary bombs.** The Soviets have two thermite bombs and two bombs with a combustible

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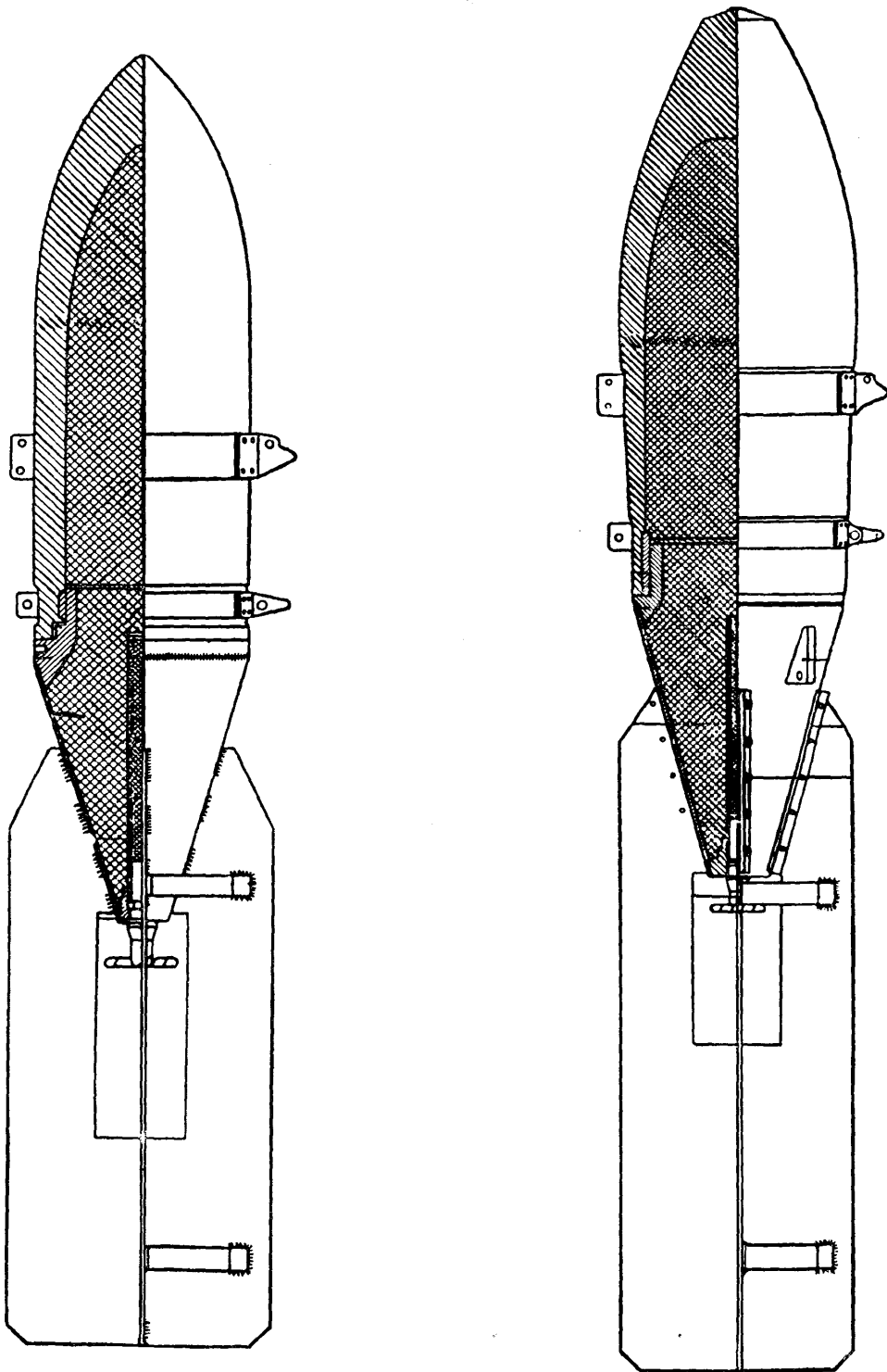


Figure 60.—Armor-piercing bombs BRAB-220 (left) and BRAB-500 (right).

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Type	Maximum diameter (inches)	Total length (inches)	Weight of filler (pounds)	Total weight (pounds)	Fuze	Remarks
A02.5	1.7	8.21	0.22	5.29	AM-A, AGM-1	Cast iron.
A02.5	2.04	8.25	0.41	6.32	AM-A, AGM-1, AV-4	
A0-8M <sub>2</sub>	2.99	12.18		16.13	AM-A, AGM-1, AV-4	With fragments.
A0-8M <sub>4</sub>	2.94, 2.97	11.39	2.2	15.65	AGM-3	Two types.
A0-8M <sub>6</sub>	2.95, 2.99	12.18			AV-4, AM-A, AGM-1	Do.
A0Kh-10		11.02	1.67	22.04	AV-4, AM-A, AGM-1	Gas with fragments.
A0-10	3.53	11.39	1.89	20.96	AV-4, AM-A, AGM-1	Cast iron.
A0Kh-15	4.2	9.43	2.53	32.76	AV-4, AM-A, AGM-1	Gas with fragments.
A0-20M <sub>1</sub>	4.16	18.82	4.93	45.98	AV-4, AM-A, AGM-1	
A0-20M <sub>2</sub>	4.51	13.24		37.98	AV-4, AM-A, AGM-1	
A0-20M <sub>3</sub>	4.71	15.91	6.61	46.36	AGM-3	Cast iron.
A0-25M <sub>1</sub>	4.78	17.64	8	51.49	AM-A, AGM-1, AV-4	
A0-25M <sub>2</sub>	4.77	20.23	6.92	54.23	AV-4	
FAB-50M <sub>2</sub>	5.91	22.38	15.21	92.59	ADP, ADS, APUV, AV-1	
FAB-50M <sub>3</sub>	5.94	23.77	15.12	88.18	ADP, ADS, APUV, AV-1	
FAB-50M <sub>4</sub>	5.97	23.65	15.14	96.38	AGP, AV-1, APUV	
FAB-50M <sub>5</sub>	5.98	25.38	14.08	101.41	APUV	Two types.
FAB-50M <sub>6</sub>	5.989	20.04		98.28	AGM-3	
FAB-50M <sub>7</sub>	6.09	25.15	19.84	107.51	AGM-3	Picric acid filler.
FAB-50M <sub>8</sub>	6.09	25.15	17.63	105.31	AGM-3	D-N naphthalene and ammonium nitrate.

Figure 61.—Characteristics of fragmentation bombs.

Type	Fuze	Number of fragments	Effective area (square yards)	Use
A02.5 (modified artillery projectile).	AM-A	70	211.69	Antipersonnel.
A02.5 (HE)	AM-A	148	845.57	Do.
A0-8	AM-A	310	1,913.6	Do.
A0-10 (cast iron)	AM-A	370	1,196	Do.
A0-15	AM-A	273	1,500.98	Do.
A0-20	AM-A	280	1,794	Moving targets, tanks, MT vehicles, and houses.
A0-25	AM-A	400	1,937.52	Do.
FAB-50	AM-A	622	3,827.2	Do.

Figure 62.—Performance of some fragmentation bombs.

Type	Maximum diameter (inches)	Total length (inches)	Weight of filler (pounds)	Total weight (pounds)	Remarks
AOKh-8	4.2	16.3-16.4	1.2 DA 3.3 metal splinters	17.6	Scatters 225 fragments 0.25-1-inch over area 246 feet in diameter.
AOKh-10	4.2	23.7-24	1.1-1.8 DA, DM, or CN 10.8 metal splinters	21.6	
AOKh-15	4.1	24-24.6	2.2 DA, DM, or CN 2.5 HE	33	Wall is 0.75 inch thick.
AOKh-25			0.8 DA or DM 3.3 HE	52	Weight of case is 39.6-41.8 pounds.

Figure 63.—Characteristics of gas/fragmentation bombs.

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naphtha charge, which also contains a thermite composition (figs. 65, 66, 67, and 68). The incendiary composition comprises from 30 to 50 percent of the total bomb weight. The combustible naphtha

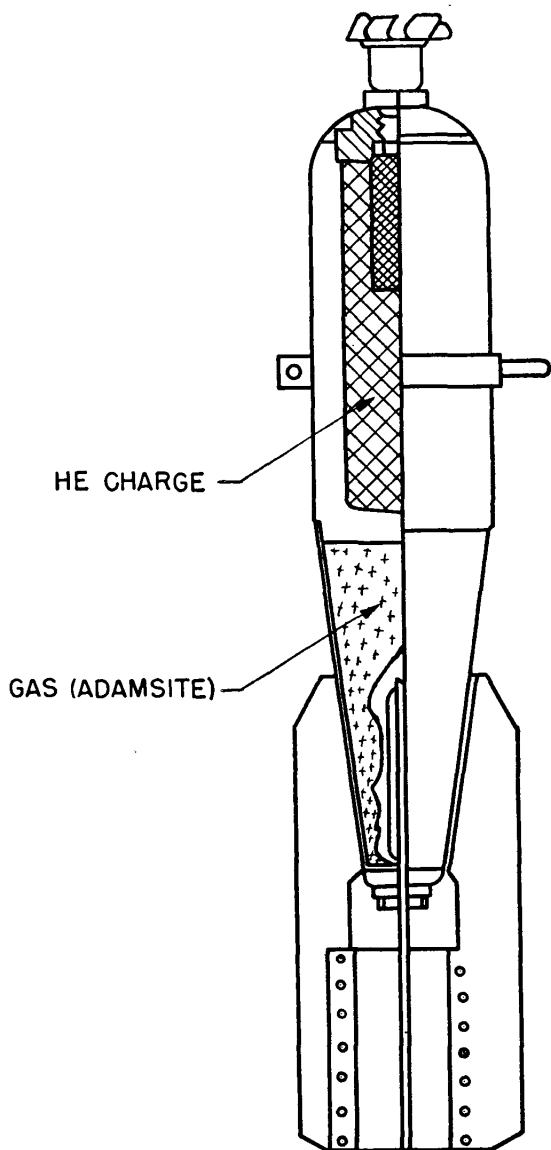


Figure 64.—Gas/fragmentation bomb AOKh-15.

composition is mainly modified kerosene. The AGM-1 and AM-B impact fuzes are used.

An explosive incendiary bomb has been reported. It is similar in shape to a high explosive bomb, and weighs 231.5 pounds. It has a thin gage steel body and tail unit. The filler is a powdery explosive mixture, in the middle of which is a bundle of 10

thermite bombs, ZAB-2.5-T (without igniter or vanes). The bomb is reported to have the APUV fuze in its nose.

**f. Cluster adapter bombs.** The popular name for this type of bomb is the "Molotov Breadbasket." The bomb is in the form of a sheet iron container, divided into sectors, in which are stowed smaller bombs up to 55 pounds in weight (fragmentation, gas, and incendiary). There are three bombs, RRAB-1, RRAB-2, and RRAB-3 (figs. 69 and 70). Upon release from the aircraft, the angled tail fins of the adapters impart rotation. A special mechanism allows centrifugal force to disintegrate the adapter, scattering the bombs.

	ZAB-50TG	ZAB-10TG	ZAB-2.5	ZAB-1-E
Maximum diameter... (inches)...	7.97	4.2	2.35	2.35
Total length... (inches)...	38.86	23.97	14.42	14.42
Total weight... (pounds)...	105.6	22	5.5	3.3
Time of burning... (minutes)...	6	4	2.3	1.2
Weight of incendiary filler (pounds)...	57.3	11	2.79	1
Effective range of flame... (feet)...	16.4	6.5	0.65	0.65

Figure 65.—Characteristics and performance of incendiary bombs.

It has been reported that RRAB-1 can hold 1,064 2.2-pound ZAB-1 incendiary bombs or 240 AOKh-10 gas/fragmentation bombs. These numbers, which are at variance with the characteristics listed in figure 64, may possibly refer either to a larger modification of this cluster adapter or to a different model of the AOKh-10 bomb.

It also has been reported that the RRAB-3 can hold 240 ZAB-1 incendiary or 46 AOKh-25 gas/fragmentation bombs.

**g. Chemical bombs.** Chemical bombs include the KhAB and AOKh gas bombs and the KRAB-25 Y AD toxic smoke bomb (fig. 71). In addition to the previously discussed AOKh-8, AOKh-10, and AOKh-15, which are used either as gas or as fragmentation bombs, there are three different sizes of KhAB gas bombs (figs. 72 and 73). The gas filler is added immediately before use. Yperit and phosgene are the principal fillers. The marking "R-5" (*Rezept-5*) identifies Yperit, a blister gas. "R-YU" identifies phosgene. Gas bombs filled with persistent gas are fuzed with either the AGM-1 or the AMA fuze. Those containing non-persistent gas are fuzed

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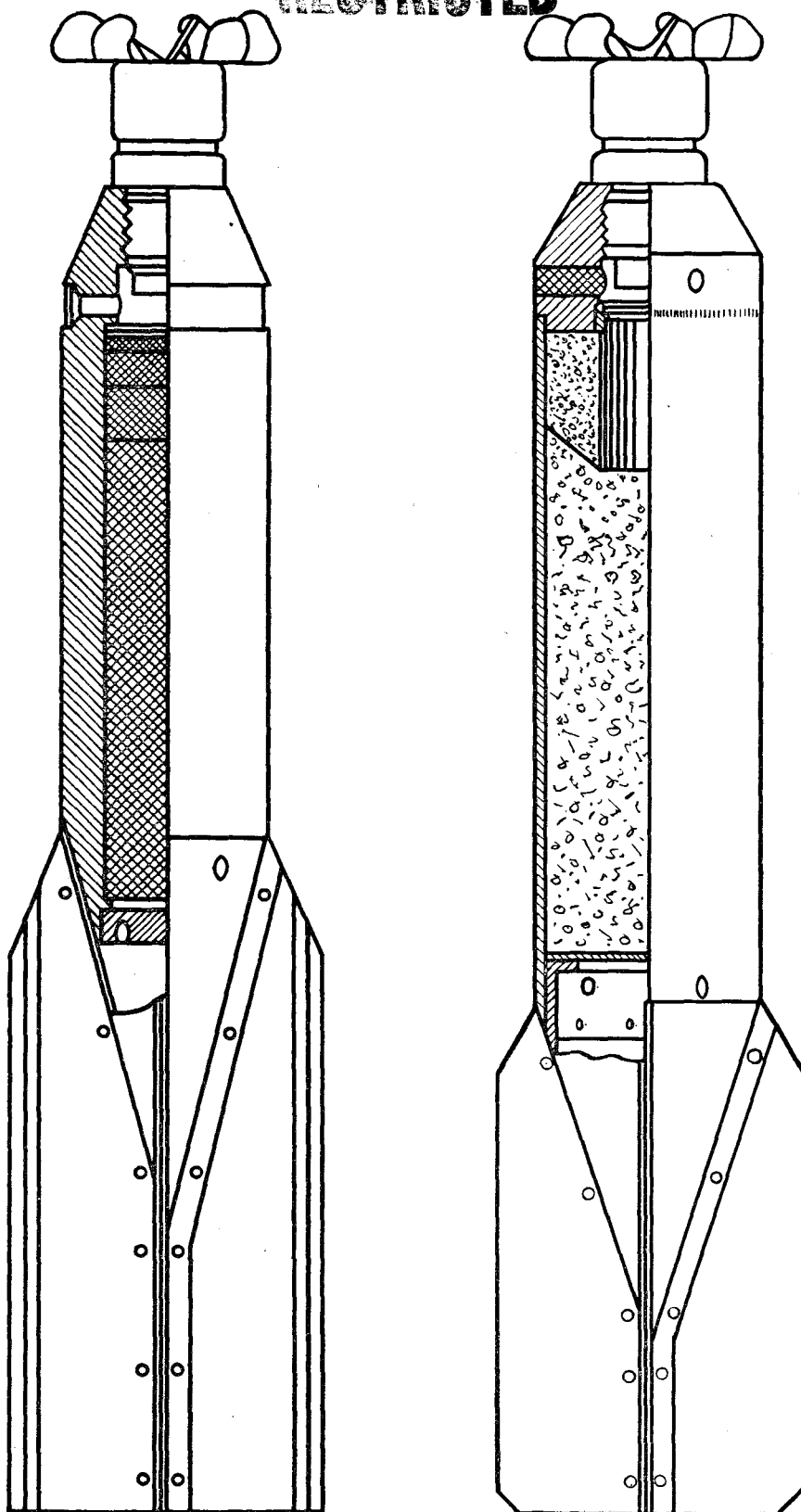


Figure 66.—Incendiary bombs ZAB-2.5 (left) and ZAB-1-E (right).

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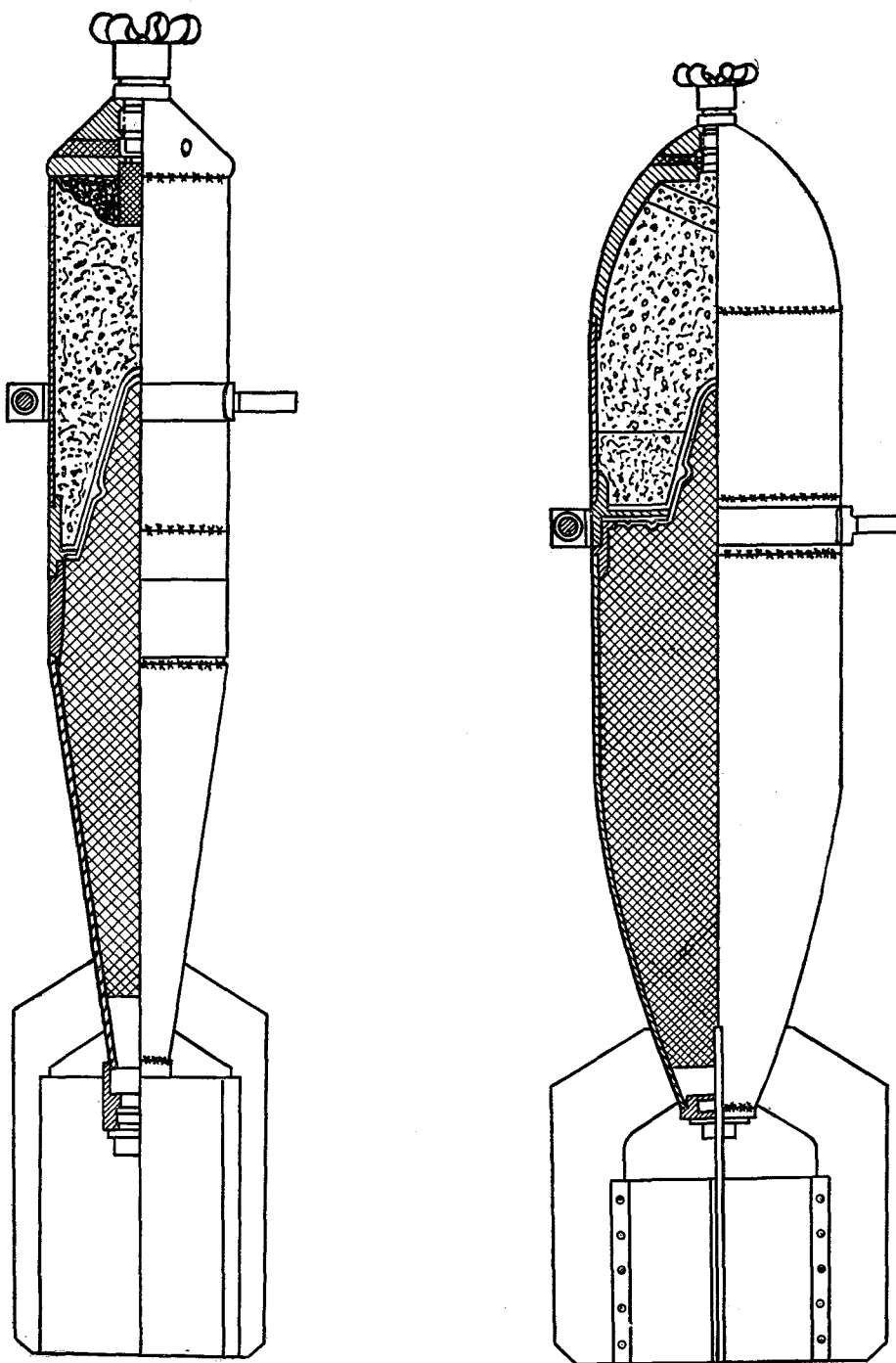


Figure 67.—Incendiary bombs ZAB-10TG (left) and ZAB-50TG (right).

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with AGDT, the TM-4, or the TM-24 (for high altitudes).

The toxic smoke bomb, KRAB-25 YaD, is used to produce either smoke or a toxic smoke (fig. 72). Adamsite is used for toxic action. It is estimated that a toxic smoke bomb develops a cloud from 50 to 65 feet high and 620 feet wide. The AGM-1 fuze is inserted in the nose of the bomb.

Type	Total length (inches)	Maximum diameter (inches)	Total weight (pounds)	Number of thermite spheres in filler
ZAB-100 TSH.....	40.9-41.7	11	143	140-145
ZAB-500 TSH.....	82.7	17.7	600	775-785

Figure 68.—Characteristics of incendiary bombs with filler of thermite spheres.

Another gas bomb, KRAB-50, also containing adamsite, has been reported. Presumably this bomb weighs 110 pounds. It is filled with a screening smoke mixture, SIV, consisting of sulphur trioxide and chlorsulfonic acid.

**h. Frangible sphere bombs.** These consist of metal ball containers filled with fluid chemical agents. Frangible spheres are released from aircraft, and are used for disseminating incendiary materials or persistent gases.

#### CHARACTERISTICS

Maximum diameter.....	4.7 inches.
Capacity.....	1.06 quarts.
Weight (filled).....	3 to 3.3 pounds.
Thickness of wall.....	0.014 to 0.02 inch.

The body of the frangible sphere is constructed in two sections, sealed together. One section is provided with four radial shear grooves. The other is fitted with a threaded filling plug. The grooved section of the sphere breaks into several pieces on impact and the filler is scattered.

The incendiary filler consists of 2.53 pounds of a liquid solution of phosphorus in sulphur and 0.22-pound of water. This filling ignites spontaneously on contact with air.

**i. Flare bombs.** The four known types of flare bombs include SAB-3, SAB-3M, SAB-15, and SAB-25 (figs. 74 and 75). The SAB-3 and SAB-3M differ very little. Flare bombs are suspended horizontally in the carrier ring. The time fuzes AGDT, TM-4, and TM-24 are installed.

**j. Miscellaneous bombs.** The navigation signal bomb, ANAB, is used as an air navigation aid (fig. 76). It is released over water, ignites on contact and burns from 5 to 10 minutes. At the time of burning a fluorescent patch is formed on the water which is visible for a considerable distance. The bomb weighs approximately 2.2 pounds. Prior to release, the sheet-metal cap over the nozzle is removed.

The propaganda bomb, AB, is used to distribute pamphlets from high altitudes. It is a wooden container which holds approximately 10,000 sheets of paper. The pamphlets are packed in rolls and are released by the AGDT time fuze at a pre-set altitude. Length of the bomb, without the fuze is 44.8 inches. It weighs 39.6 pounds.

**k. Aerial torpedoes.** There are two known types of torpedoes in the Soviet air forces, the

	BRAB-1	BRAB-2	BRAB-3
Maximum diameter.....(inches)...	28.29	23.58	20.43
Total weight.....(pounds)...	2,640	1,430	990
Total length.....(inches)...	152.09	128.7	89
Filler (number of bombs):			
Type AO-8.....	84-130	50-78	34
Type AO-10.....	100	66	25
Type AO-25.....	40	19	13
Type ZAB-2.5.....	580	260	116
Radius of scatter (feet):			
AO-8 from 6,561 feet.....	885.8-1,804.4	770.8-1,722.4	738.1-1,181
from 16,404 feet.....	1,000.6-2,296.5	869.4-1,842.8	820.2-1,640.4
AO-10 from 6,561 feet.....	1,374.3	2,165.3	1,099
from 16,404 feet.....	1,968.4	2,542.6	1,230.3
AO-25 from 6,561 feet.....	1,525.5	918.6	623.3
from 16,404 feet.....	1,788	1,345.1	1,115.4
ZAB-2.5 from 6,561 feet.....	2,591.8	3,116.7	2,181.7
from 16,404 feet.....	3,362.8	4,068.1	2,854.2

Figure 69.—Characteristics and performance of cluster adapter bombs.

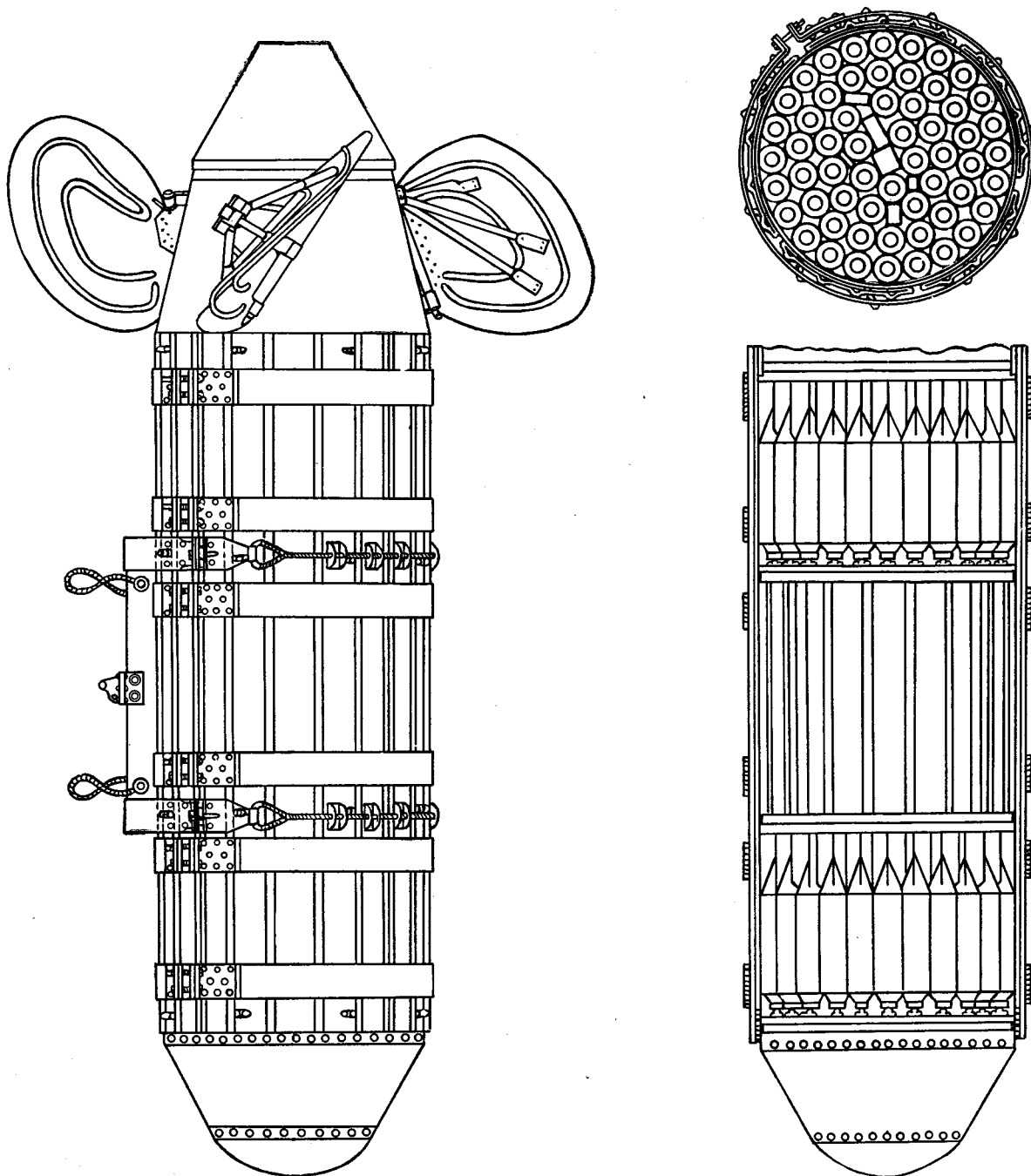


Figure 70.—RBAB-3 cluster adapter bomb.

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	Gas bombs				Toxic smoke bombs
	KhAB-500	KhAB-200-R-5	KhAB-200-R-YU	KhAB-25	KRAB-25 YaD
Maximum diameter.....(inches).....	17.7	12.6	12.6	8	8
Total length.....(inches).....	93.7-94.9	85.3	85.3	34.6-34.8	33-34.5
Total weight.....(pounds).....	600-690	354.2-363	378.4-418	57.2-61.6	66-75.9
Gas filler.....(pounds).....	374-407	171.6-183.7	193.6-202.4	28.6	16.5-17.6
Explosive filler.....(pounds).....	2.5-3.6	1.1-1.48	.....	0.9	5.7-5.9

Figure 71.—Characteristics of gas and smoke bombs.

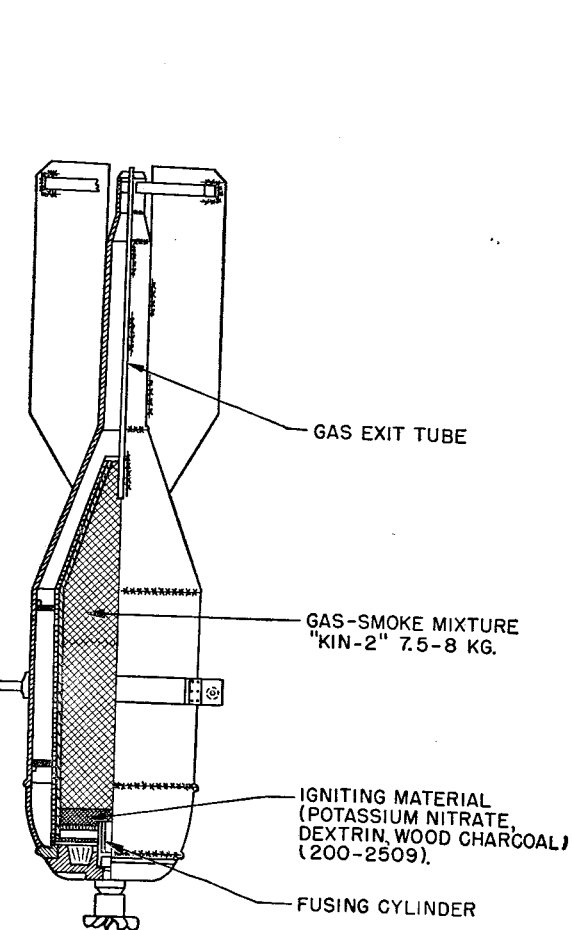


Figure 72.—Smoke bomb KRAB-25 YaD.

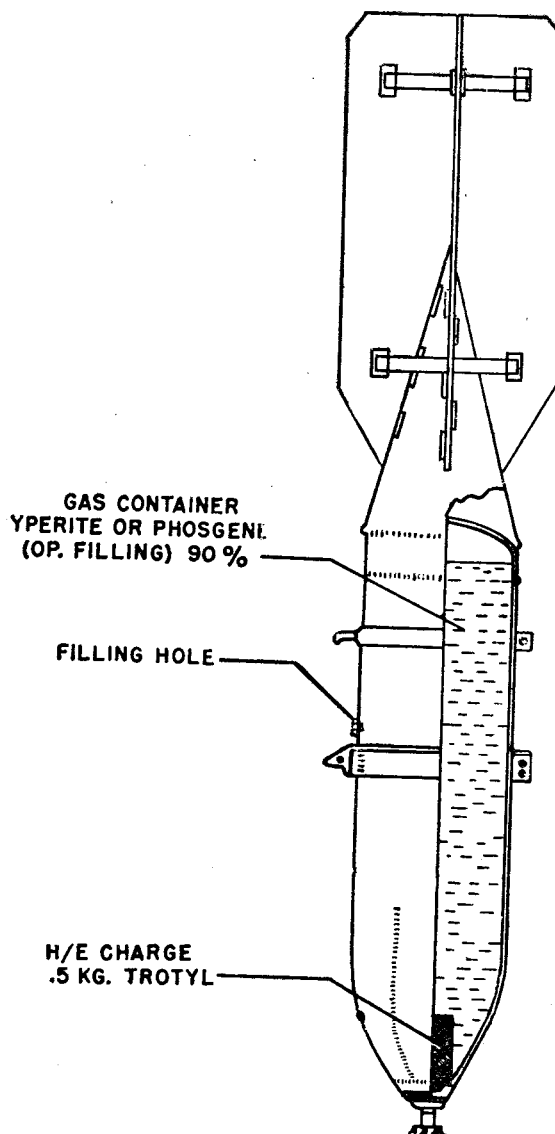


Figure 73.—Gas bomb KhAB-200.

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	SAB-25	SAB-15	SAB-3M	Photographic
Maximum diameter				
(inches) ..	7.46	6.28	3.73	7.97.
Total length.....(inches) ..	68.53	40.47	20.35	35.17.
Total weight.....(pounds) ..	51.5	31.7	8.8	77.1.
Time of burning				
(minutes) ..	2.2	2.4	3.5	1/6 second.
Weight of filler.....(pounds) ..	26.4	21.2	4.8	44.
Candle power.....	700,000	500,000	22,000	230,000,000.
Rate of fall				
(feet per second) ..	9.8	7.8	14.7	

Figure 74.—Characteristics and performance of flare bombs.

45-36-AN for release at low altitudes and 45-36-AV for release at higher altitudes. The first torpedo is released by the PTN-4 sighting gear. The second type is released by the normal bomb sight OPB-1. Each type weighs 2,068 pounds.

**1. Rockets.** For rocket projectiles, see chapter VIII.

## 2. BOMB FUZES

Soviet bomb fuzes are obsolete in comparison with United States and British fuzes, with inadequate detonating and safety features and with poor precision

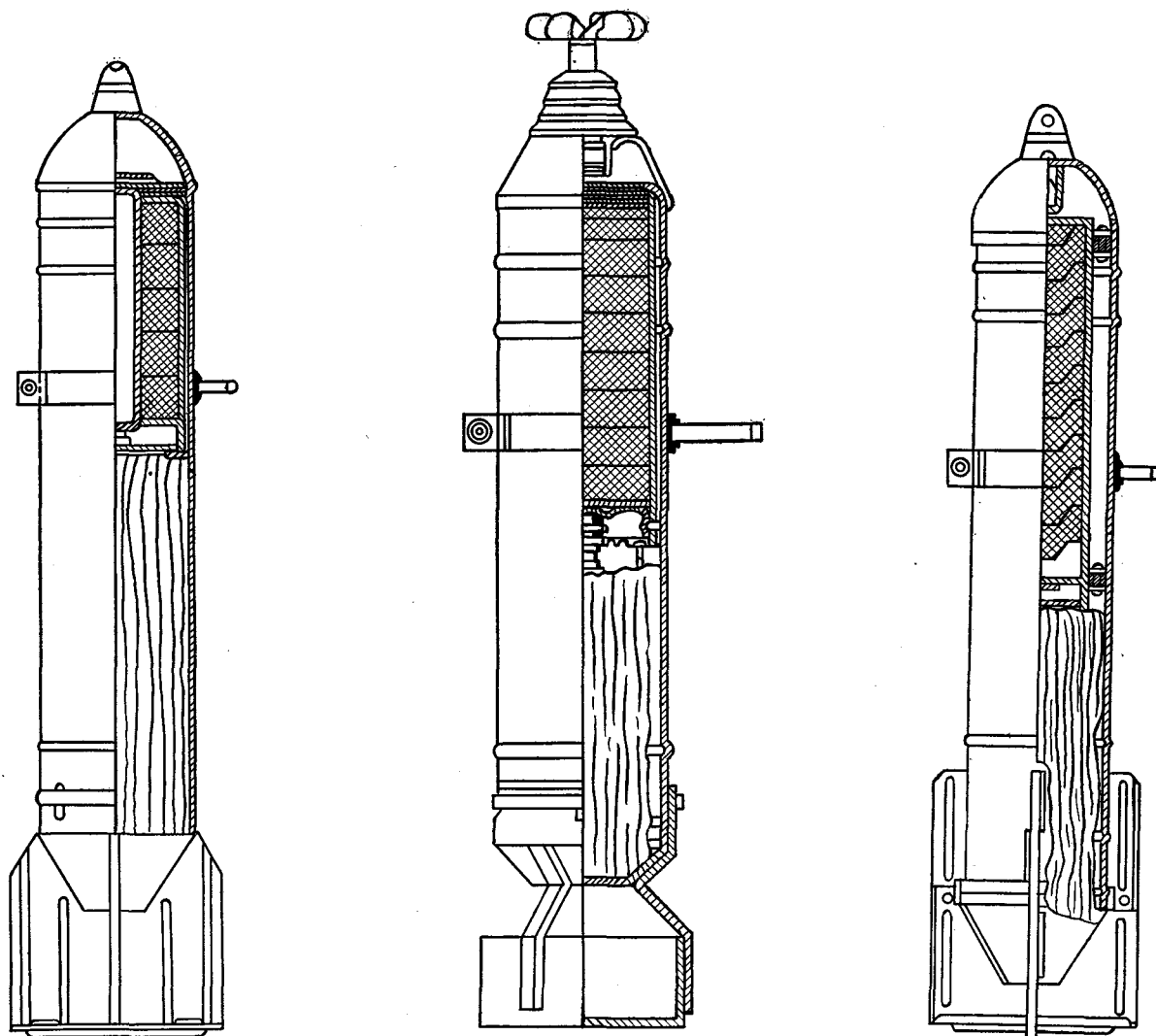


Figure 75.—Flare bombs (from left to right) SAB-25, SAB-3M, and SAB-15.

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and time delay (fig. 77). They also lack suitable anti-disarming features. Development of bomb fuzes is far behind that of Soviet artillery fuzes.

**a. Fuzes without delay.** Several Soviet bomb fuzes do not contain delay features.

**AV-4 NOSE.** The AV-4 is activated by the rotation of the arming vanes. The action appears to

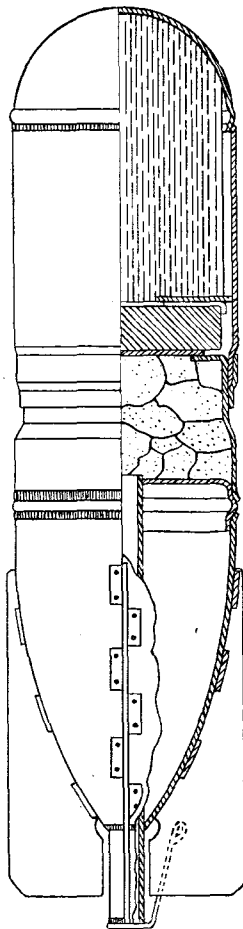


Figure 76.—Navigation signal bomb ANAB.

compress and heat the air in the fuze chamber which, in turn, ignites the detonator. Instantaneous action on impact may be effected by removing the side screw, which permits the flash of the igniter to pass through a flash tube to the booster. If the side screw is retained, a slight delay action results, because the flash must pass through an intermediate powder chamber before reaching the booster.

**AM-A PLAIN NOSE.** This fuze is an inertia-type with a safety cap and arming vanes. The rotation

of the arming vanes apparently detaches the safety cap, which arms the fuze and the detonation occurs on the impact of the simple inertia striker against the igniter.

**AM-B.** The AM-B is similar to AM-A fuze, with a comparable inertia striker. It is fitted with a percussion primer rather than a detonator.

**AM-AB/V AND AM-BB/V.** These also are inertia fuzes. They differ from the AM-A in that the outer safety caps are removed by hand before use, rather than automatically in flight by arming vanes.

**AGM-1 AND AGM-3.** These are impact fuzes, provided with safety arms, and armed in flight by arming vanes. The rotation of the arming vanes forces out the safety arm, arming the fuze. On impact, the main spring is crushed and the striker is driven against the detonator. No delay is provided. These fuzes have a beveled, sliding collar in the head to insure detonation at varying angles of impact.

The AGM-1 appears to differ from the AGM-3, which has only a percussion primer, primarily in the construction of the detonator.

**b. Fuzes with delay.** The Soviets use several types of delay bomb fuzes.

**AV-1 NOSE AND TAIL.** The AV-1 is an always impact fuze, with arming vanes and a fixed delay of from 25 to 27 seconds.

**ADSU.** The ADSU probably replaced the APUV fuze. It is not an all-ways type. It has arming vanes, an inertia striker, and fixed delay.

**ADS TAIL.** The ADS is believed to be obsolete. It has arming vanes and a fixed delay of from 0.15 to 0.3 second. A fuze similar to the ADS, designated ADSO, is considered obsolete and has no delay element.

**VARIABLE DELAY FUZE APUV.** This is suitable for nose and tail fuzing. It has arming vanes resembling the AV-4 in construction and in action, it is detonated by the increase of temperature caused by compression. By taking out the side screws, adjustment for delay and instantaneous action may be made. With screw "Z" removed, 0.1 second delay is effected. With screw "M" removed, no delay action is obtained. With both screws left in, 0.3 second delay is obtained. This fuze is used on high explosive bombs.

**c. Time Fuzes.** Seven different time fuzes are used.

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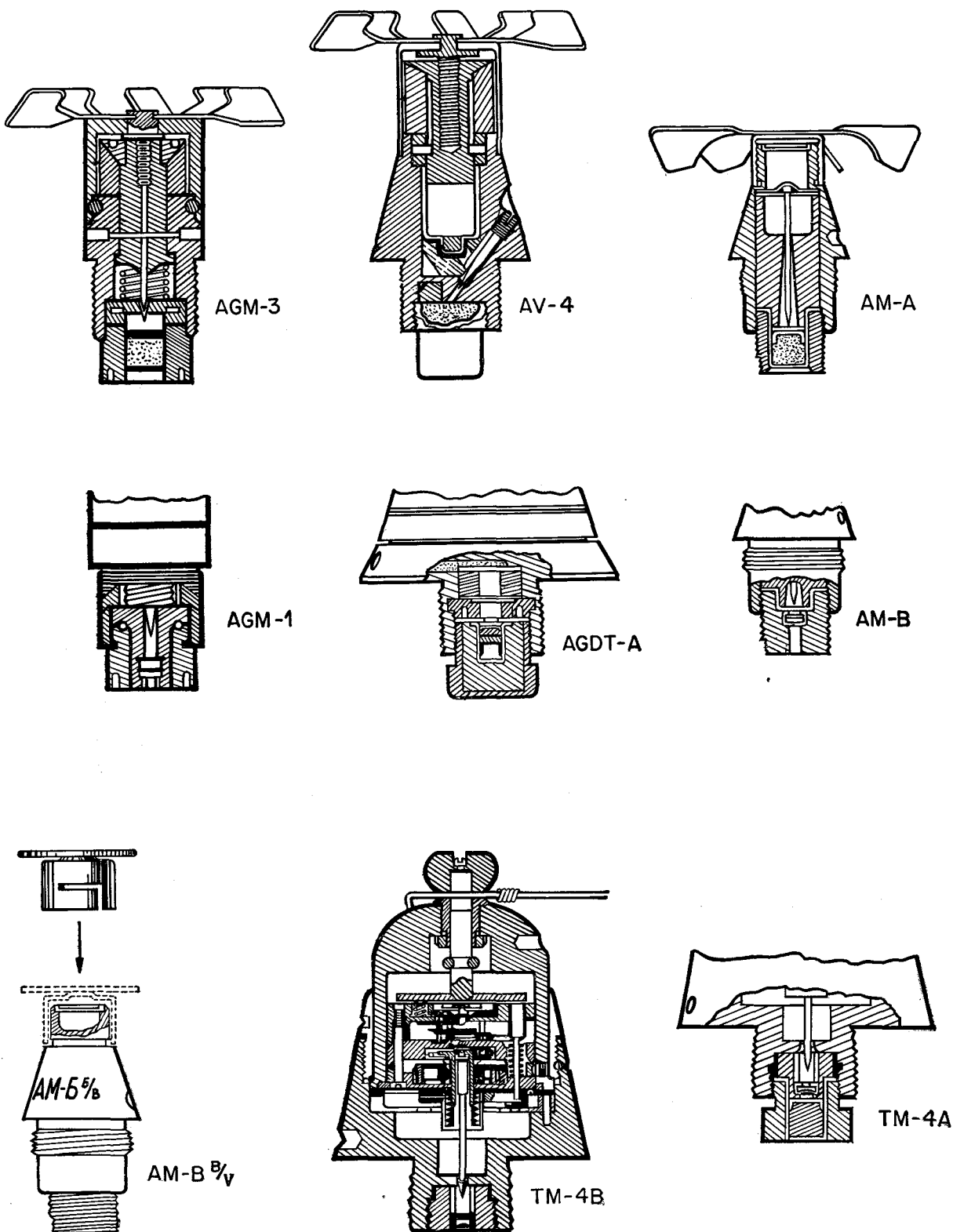


Figure 77.—Some Soviet bomb fuzes.

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TM-4A. The TM-4A is operated by a mechanical time clock, which can be set at from 6 to 40 seconds. A wire release activates the clock when the bomb is released. The bomb is detonated above the ground. This type of fuze is used on fragmentation, gas, and photographic flash bombs.

TM-4B. The TM-4B is similar to the TM-4A. The mechanical time clock may be set from 2 to 40 seconds. It is used on flares and smoke bombs.

AGDT-A. The AGDT-A is a nose fuze to detonate bombs above ground. It has a selective time setting of from instantaneous to 5 seconds and 5 to 22 seconds, controlled by a powder train activated by pre-set arming vanes. It is used on fragmentation and flash bombs.

AGDT-B. The AGDT-B is similar to the AGDT-A. It has no special markings and is used for flares and gas and smoke bombs.

ADP TAIL. The ADP fuze has arming vanes, an inertia striker, and a variable powder train. The setting ring may be adjusted for from 0.01 to 0.05 second delay, from 0.05 to 0.15 second delay or from 5 to 22 seconds. It is used on high explosive bombs.

ADP. The ADP is the same as the ADP tail fuze, but is an older model. It resembles a projectile fuze in shape. It does not employ a safety pin.

AGP. The AGP is a nose, time impact fuze. It has arming vanes, adjustable delay, inertia striker, and rotatable pyrotechnic time ring. It can be adjusted for from 0.01 to 0.05 second, from 0.05 to 0.15 second, or from 22 to 35 seconds. It is used for fragmentation bombs dropped from more than 130 to 165 feet.

### 3. BOMB SHACKLES AND RELEASE GEAR

Soviet bombs usually are carried horizontally. In some of the older bombers, bombs weighing up to 220 pounds were carried vertically. Small bombs are attached by one lug. Those weighing more than 220 pounds are attached by two lugs. These lugs are made fast to the bands supporting the bombs. Vertically-carried bombs are supported under the tail. Release usually is effected by a cartridge fired by an electrically-heated filament. The resulting gases open the bomb slip. Electromagnetic release also is used occasionally. Emergency mechanical release is provided. Electrical bomb release is effected by the ESBR bomb distributor. Mechanical release is effected by the emergency gear ASBR.

Bombs may be dropped either armed or safe. When dropped armed, the safety pin on the arming vanes of the fuze is withdrawn mechanically. It is not withdrawn when bombs are dropped safe.

There are many models of bomb shackles, each adapted for the particular aircraft in which it is installed. Bombs weighing from 500 to 1,000 pounds are stowed internally and horizontally. Gas bombs

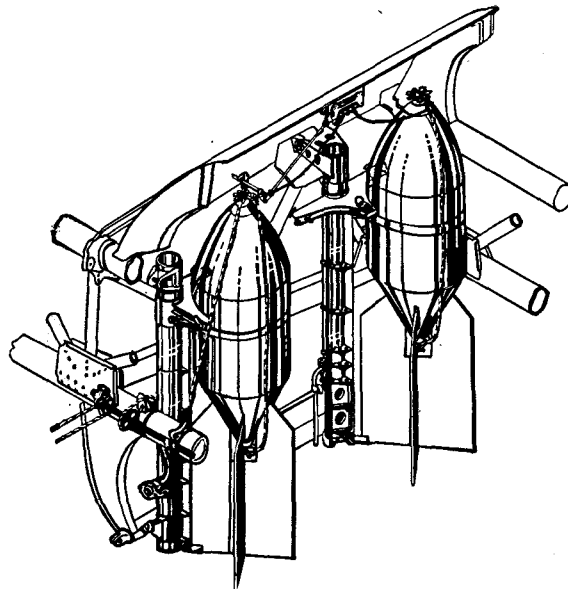


Figure 78.—Verticle bomb shackle DER-34.

are carried externally. In the TB-3F bomber, there are two fuselage bomb racks, each carrying five 220-pound bombs horizontally, one above the other. Under the fuselage are three bomb stations, the two outer station for 1,000-pound bombs and the middle station for 2,000-pound bombs.

The PE-2 bomber has stations in the fuselage, under the wings, and in the engine nacelles. There are interchangeable racks which can be installed in single-engined fighter-bombers for stowage of bombs weighing up to 200 pounds. Release is the same as for bombers, normally by an electrically-fired cartridge and in emergency mechanically. Some bombers have a permanently built-in hoisting winch for loading large bombs.

Bomb doors usually are opened and are closed mechanically by a hand ratchet.

**a. Bomb shackles.** Two types of bomb shackles used by the Soviets are the DER-34 and the DER-21.

**VERTICAL BOMB SHACKLE DER-34.** The DER-34 is used for the vertical stowage of one to two bombs, each weighing from 50 to 200 pounds

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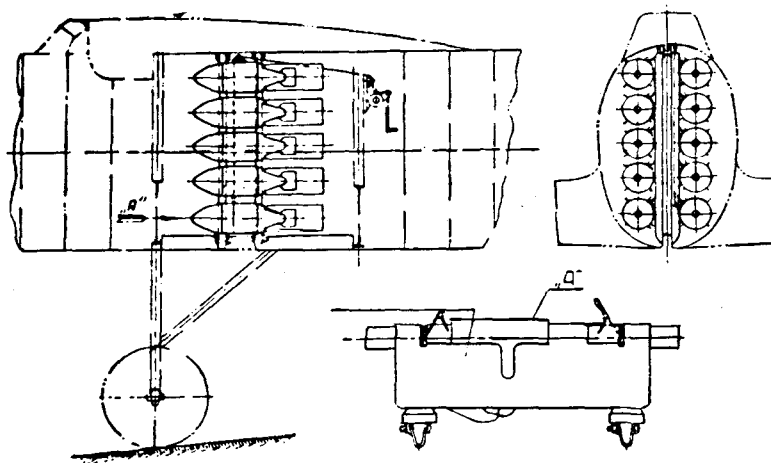
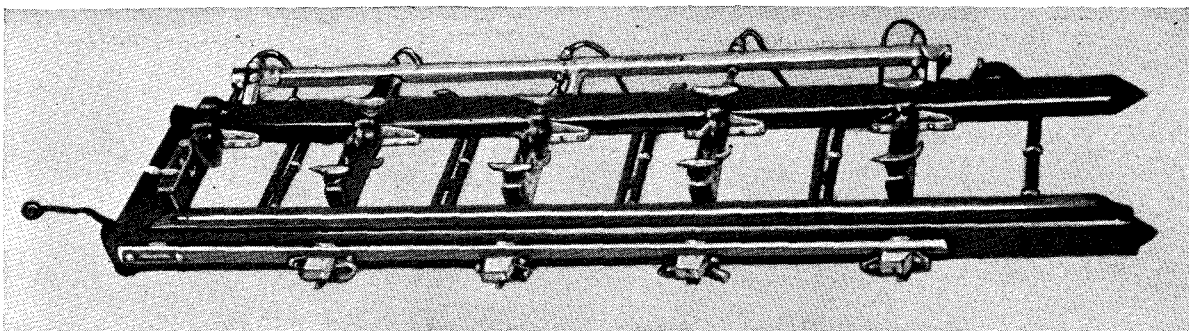


Figure 79.—Horizontal bomb shackle DER-21.

(fig. 78). The bombs are supported by a claw, which is attached under the tail and which is held by a band encircling the upper part of the bomb. Normal release is accomplished by an electrically-fired cartridge controlled by intervalometer ESBR. Emergency release is achieved mechanically by the ASBR-3 intervalometer.

**HORIZONTAL BOMB SHACKLE DER-21.** Two bomb stations are built inside the fuselage of the IL-4 (DB-3F) (fig. 79). They carry five bombs, weighing up to 220 pounds, horizontally, or an AK-2U container. Normal bomb release is achieved by an electrically-fired cartridge. Emergency release is mechanical. A bomb-hoisting winch is built into the aircraft. The shackle weighs 77 pounds, is 65.23 inches deep, 23.58 inches long, and 4.71 inches wide.

**b. Intervalometers.** Intervalometers are used to control the release of bombs.

**ELECTRICAL BOMB INTERVALOMETER ESBR-2.** The ESBR-2 intervalometer is fitted as standard equipment for bomb release in nearly all new Soviet aircraft. The ESBR-2 enables 20 bombs to be re-

leased at time intervals or from 0.1 to 1.5 second, either singly or 2, 3, or 4 bombs simultaneously (fig. 80). The total number of bombs to be released can be regulated by means of a selector.

The control panel of the intervalometer contains a selector switch to determine the total number of bombs to be dropped, a distributor switch to determine the number of bombs to be dropped at each interval, and a time interval switch. Two indicator lamps, wired parallel, are provided for each bomb station, and are turned on by pressing down on the left-hand switch. The lamps are covered by red filters immediately upon release of the bombs.

The selector switch is located on the upper part of the panel. The total number of bombs to be dropped is set on the selector switch. It consists of a rotary contact knob and a contact track, with 20 contacts. The first contact is marked "salvo" for a single release. The second contact is marked "null" and returns the release gear to null.

To the left and below the selector is the distributor. The distributor determines the number of bombs to

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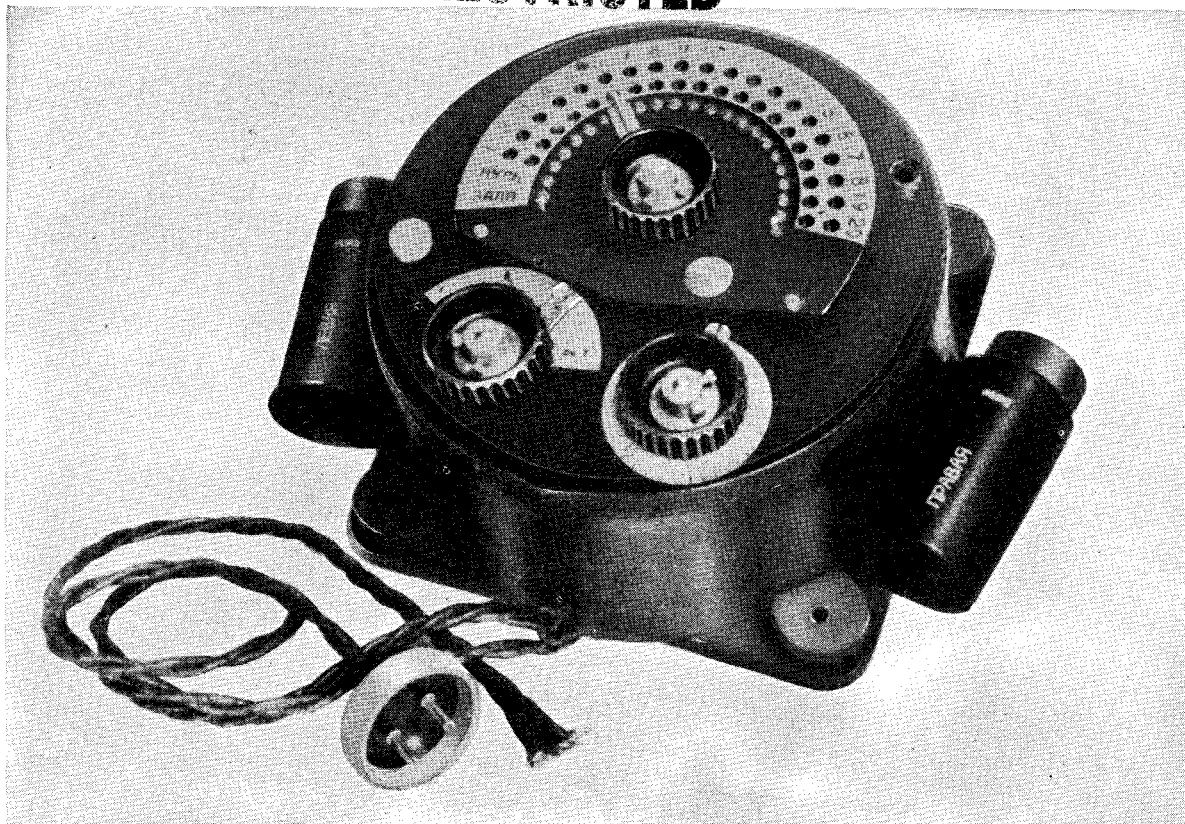


Figure 30.—Electric bomb intervalometer ESBR-2.

be dropped at each interval. It can be set for 1, 2, 3, or 4 bombs.

The time interval switch is on the right. It provides time intervals of from 0.1 to 1.5 second.

Thus, by setting the selector at 15, the distributor at 3, the time interval at 1, and pressing the release switches, 3 bombs will be dropped every second until a total of 15 have been dropped. By setting the selector at "salvo" and the distributor at 4, 4 bombs are released simultaneously.

The intervalometer weighs 13.2 pounds. It is electrically-heated and is protected by a felt and leather cover. It operates on the 24-volt aircraft electric system.

**ELECTRICAL BOMB INTERVALOMETER ESBR-5.** The ESBR-5 intervalometer is used in the TB-3 and TB-3F aircraft, each of which has two internal bomb racks built into the fuselage. Each rack carries five bombs stowed horizontally one above the other. It can be arranged for only two bombs to be released simultaneously. The ESBR-5 is similar to the ESBR-2 in construction, except for the bomb dis-

tributor switch, which allows the release of not more than two bombs simultaneously.

#### c. Frangible sphere release assemblies.

Three models of release assemblies can be used for dropping frangible spheres. Model AVK-1 is adapted to small bombs as well as frangible spheres. Release assembly AK-2, and its smaller modifications AK-2u and AK-2uM, are designed for frangible spheres only.

**AVK-1 RELEASE ASSEMBLY.** The AVK-1 is a cylindrical metal container with a hemispherical lid at one end and a flat cover at the other. The containers can be suspended either vertically in the bomb rack or horizontally under the wings. Release is effected electro-pyrotechnically. Metal or wooden spacers are used to adapt the container to carry either frangible spheres or small size bombs.

#### CHARACTERISTICS

Total length.....	42.8 inches.
Maximum diameter.....	11.3 inches.
Weight (empty).....	42.9 pounds.
Capacity.....	30 frangible spheres or 28 ZAB-I-E incendiaries.

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**AK-2 AND AK-2U RELEASE ASSEMBLIES.** These are carried in the fuselage attached to the bomb rack. They consist of a frame work supporting sixteen vertically disposed duralumin tubes holding the frangible spheres (fig. 81). Each unit is fitted with four hinged lids at the bottom, each lid closing an outlet. Release is effected mechanically or electrically, the four lids of each unit being opened either consecutively or simultaneously. Four release assemblies can be carried by a four-engined bomber, while a two-engined aircraft can carry two of the shorter AK-2U model.

#### CHARACTERISTICS

	AK-2	AK-2U
Over-all length.....	76.9 inches.....	52.8 inches.
Cross section.....	45.4 x 7.9 inches..	45.4 x 7.9 inches.
Weight (empty)---	132 pounds.....	105.6 pounds.
Capacity.....	240 spheres.....	160 spheres.

### Section IV. SIGHTS

#### 1. GUN SIGHTS

**a. Fixed.** In the early part of World War II, an Aldis-type sight with an auxiliary ring-and-bead sight was installed. This type was replaced by a series of reflector sights. The PAK sight was equipped with a ring-and-bead sight and was used only as a gun sight, while the later models can be used as bomb sights. For example, the PBP sight

can be used also as a rocket projectile and dive bombing sight.

**b. Flexible.** A sight of the "moving vane" type, with a relative speed ring rear sight, has been used. A more recent sight is the PMP, which has an automatic "own speed adjustment," and which, with additional apparatus, also can be used as a low-level bomb sight.

**c. Types of gun sights.** Several different types of gun sights are in use.

**REFLECTOR SIGHT PAK-1.** The PAK-1 is used for fixed guns. It has an auxiliary sight, consisting of a ring and bead, attached to its side. The PAK-1M and PAK-2 are modifications of the PAK-1.

#### CHARACTERISTICS

Aperture.....	4.32 inches.
Length.....	9.43 inches.
Width.....	4.71 inches.
Height.....	11.79 inches.
Weight.....	5.76 pounds.

**REFLECTOR SIGHT PBP-1A.** The PBP-1A is a dive-bombing sight and a fixed gun sight. It is used in the new single-seat fighters and in the PE bomber. A range adjustment, 20 degrees elevation and 5 degrees depression, is effected by tilting the reflector. It is illuminated by daylight or by an electric bulb. The reticle consists of two concentric circles and a cross with range graduations.

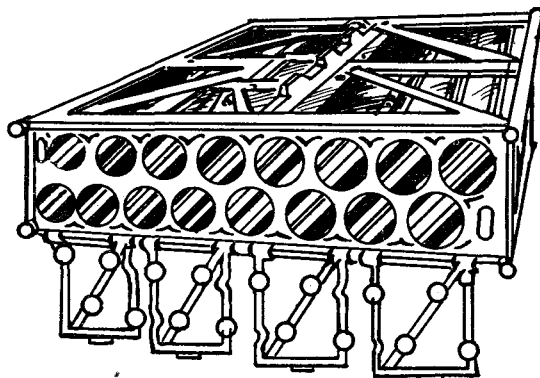
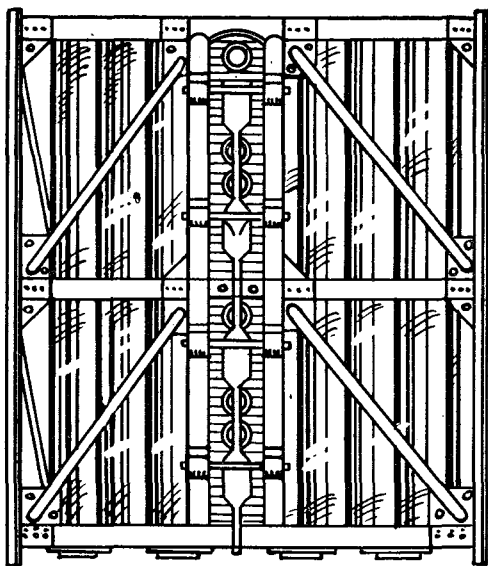


Figure 81.—AK-2 frangible sphere release assembly.

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## CHARACTERISTICS

Focal length.....	2.39 inches.
Lens aperture.....	1.57 inches.
Angle formed by radius of small sighting ring.....	4 degrees.
Angle formed by radius of large sighting ring.....	6 degrees.
Limit of bombing angle.....	+ 20 degrees, — 5 degrees.
Height.....	6.28 inches.
Width.....	3.93 inches.
Depth (without illuminating in- stallations).....	4.32 inches.
Depth (with illuminating instal- lations).....	4.91 inches.
Weight.....	1.76 pounds.

REFLECTOR SIGHT PBP-1. The PBP-1 differs from the PBP-1A in that it is possible to put on a drift angle up to 20 degrees right or left. Weight is increased to 3.08 pounds.

REFLECTOR SIGHT PAN-23. The PAN-23 is similar to the PBP-1A in construction, and was developed along parallel lines. It has electrically illuminated reticles, which frame the target, for range computation. The reticles open to an angle of 17 degrees between the framing lines of the sight. It can be used as a gun sight for fixed or flexible guns and as a dive-bombing sight.

## CHARACTERISTICS

Depth.....	6.36 inches.
Width.....	3.45 inches.
Height.....	5.1 inches.
Focal length.....	2.63 inches.
Weight.....	1.85 pounds.

MECHANICAL GUN SIGHT PMP-3. The PMP-3 is designed for flexible machine guns. Lateral deflection correction, to compensate for the position of the target in relation to the axis of the gunner's plane, and vertical deflection correction are accomplished automatically.

It consists of a ring front sight and a bead rear sight. The distance between the two is adjustable, according to the speed of the gunner's aircraft. Corrections are effected by horizontal or vertical rotation of the ring, which is mounted on a ball and socket. Lateral deflection correction is accomplished by a cam rotated by a flexible shaft, which is actuated by a gear wheel on the turret ring. Vertical deflection correction is accomplished by a rod attached to the pivot point on the mount.

The sight is graduated for ranges up to 2,625 feet and air speeds up to 280 miles per hour.

## CHARACTERISTICS

Diameter of bead.....	0.1179 inch.
Diameter of rings.....	2.35, 1.17, and 0.27 inches.
Distance from ring to bead.....	5.3 to 8.96 inches.

MECHANICAL GUN SIGHT PMP-6, AUXILIARY APPARATUS PNB-2. The PMP-6 is a modification of the PMP-3. Distance from the ring to the bead is from 6.48 to 8.96 inches. For both sights, a special auxiliary PNB-2 is provided to adapt the sight for use as a bomb sight for horizontal flight. It is attached to the side of the sight.

The PNB-2 is graduated for 100- and 200-pound bombs, and for altitudes of from 165 to 2,300 feet. The gun is depressed below the longitudinal plane of the aircraft until an altitude reading corresponding to the altitude of the plane appears on a vertical sliding scale. This sets the proper dropping angle. Compensation for the different trajectories of the bombs is achieved by adjustments on a metal scale, which changes the dropping angle correspondingly. The bombardier then releases his bombs when the target appears in the ring and bead sight.

TELESCOPIC SIGHT OP-2L. This sight for fixed guns is used on a retractable mount in the belly of the fuselage of the PE-2 and IL-4. The line of sight is refracted 160 degrees forward to parallel the axis of the bore.

## CHARACTERISTICS

Length of eyepiece tube.....	14.14 inches.
Length of lens tube.....	9.9 inches.
External diameter of tube.....	1.92 inches.
Angle between lens tube and eye- piece tube.....	106 degrees.
Weight.....	6.6 pounds.
Magnification.....	None.
Field of Vision.....	40 to 42 degrees.
Aperture.....	0.7 to 0.78 inch.
Focal length.....	2.05 inches.

## 2. BOMB SIGHTS

a. General. The Goerz-Boykov optical sight was used for normal bombing in horizontal flight as early as 1941. The OPB-1, an obsolete model, was merely a telescopic sight for which the bombardier had to compute the dropping angle. In the OPB-2, computation of the dropping angle is determined automatically. The reflector sights PBP-1A and PBP-1 are used for dive bombing and firing of rocket projectiles. The NKPB-3 is a hand-operated, semiautomatic bomb sight.

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**b. Types of bomb sights.** Three types of bomb sights are in general use.

**BOMB SIGHT OPB-1.** There are four models of this sight: the OPB-1, introduced in 1933; the OPB-1A, a shortened sight; the OPB-1M, introduced in 1939; and the OPB-1AM, a new shortened design. The later models are equipped with thermostatically-controlled electrical heating and are so designed that the telescope tube can be adjusted to the height of the bombardier's eyes.

The OPB-1, a copy of the Goerz-Boykov, is an optical sight. The dropping angle must be determined and then set on a scale. The telescope is housed in a ball joint to facilitate hand adjustment to center the bubble. The bearing ring is rotatable, to allow for the estimated drift angle. The vertical sighting angle may be adjusted by rotating a prism.

Ground speed is determined with the aid of a stop watch attached to the telescope. The time required to track an object directly beneath the plane through 45 degrees is measured. Ground speed then is computed. The dropping angle for the type of bomb, ground speed, and altitude is taken from tables. The dropping angle is set on the sight by means of an adjustable collar. The target is followed by rotating the sight angle knob. The bombs are released when the reticle intersects the target. Two buttons beside the release mechanism are used to guide the pilot to the right or to the left during the bomb run.

#### CHARACTERISTICS

	OPB-1M	OPB-1AM
Length-----	45.98 inches-----	38.51 inches.
Weight-----	13.2 pounds-----	12.12 pounds.
Magnification-----	1.2 x-----	1.35 x.
Field of vision-----	32 degrees-----	30 degrees.
Exit pupil-----	0.27 inch-----	0.31 inch.
Focal length-----	1.41 inches.	
Division of the Diopter scale-----	4.0 to -4.0.	
Diameter of the leveling bubble-----	0.13 to 0.21 inch.	
Diameter of the tube-----	1.96 inches.	
Sighting angle variation limits-----	-15 degrees to +75 degrees.	
Dropping angle variation limits-----	-5 degrees to +60 degrees.	
Smallest angular calibration-----	0.5 degree.	
Current consumption-----	24 V., 4.2 A.	
Base plate:		
Dimensions-----	8.13 x 4.32 x 4.48 inches.	
Weight-----	4.4 pounds.	

**TELESCOPIC BOMB SIGHT OPB-2.** The OPB-2, an adaptation of the Goerz-Boykov sight, was adopted in 1937 and has been used in recent bombers

for bombing from horizontal flight. It is similar to the OPB-1, but is equipped with an automatic dropping angle computer, and may be used for both stationary and moving targets. The dropping-aiming computation procedure can be used in navigation for computing ground speed and drift. Ground speed is determined automatically and is applied by the computer during sighting. Readings can be taken from a dial on the computer.

After leveling the bomb sight, the bombardier sights the telescope on the target so that the level bubble and the reticle, coinciding with it, rest exactly on the target. The computer then is set in motion, and rotates the telescope vertically. The rate of rotation is controlled by the bombardier to hold the reticle on the target. He rotates a dial which changes the input rate of the computer by moving a gear over the surface of a rotating cone or spindle. The computer also moves the level bubble off the target as the telescope is rotated, and then on it again at the moment the bomb release point is reached. When the rotation of the telescope is synchronized with the speed of approach to the target, the computer is furnished with the target location and the ground speed of the plane. This data, together with the altitude, size of bomb, and drift settings, supplies the computer with all necessary information.

For navigation, the telescope also may be removed from its housing and fixed vertically for computation of ground speed and drift.

#### CHARACTERISTICS

Magnification-----	1.2 x.
Sighting angle-----	32 degrees.
Exit pupil-----	0.28 inch.
Adjustment of front sight-----	0.11 to 0.47 inch.
Sighting angle adjustment-----	90 degrees to 2 degrees 21 minutes.
Trail angle adjustment (automatic correction for drift)-----	0 to 12 degrees.
Drift adjustment-----	+ 20 degrees.
Maximum running time of clock-work mechanism-----	6 minutes.
Height scale range-----	3,280 to 39,396 feet.
Ground speed range-----	6.1 to 341.7 miles per hour.
Weight of footplate-----	40.56 pounds.
Length of telescope-----	42.44 inches.
Current (heating)-----	24 V, 6A.
Current (illuminating)-----	24 V, 0.2A.

**BOMB SIGHT NKPB-3.** This sight can be used only with a predetermined dropping angle.

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	VAP-4M	VAP-6M	VAP-500	VAP-1000
Length..... (inches)...	64.8	44.4	103.1	133.62
Total capacity.... (gallons)...	21.7	11	92.5	186.3
Operational capacity. (gallons)...	20.3	10	83.2	177
Weight empty..... (pounds)...	42-46.4	22.4	188	275
Weight filled..... (pounds)...	264-275	136.6	1,089	2,191
Diameter of discharge opening..... (inches)...	5.1	4.7	7.9	.....
Duration of spray release (seconds)...	3-6	3-4	3-9	6

Figure 82.—Characteristics and performance of nonpressure spray tanks.

The dropping angle is set on the dropping angle scale by turning a knurled knot. The target then is sighted through a Revi sight. By turning a knob on the left of the sight, the reticle cross is held on the target. A definitely perceptible resistance is felt when the preset dropping angle is reached, and a visual indication is provided in the graduated cross. In case of failure of electrical illumination, a mechanical auxiliary sight can be used. Leveling of sight is accomplished by means of longitudinal and horizontal segments and worm drives.

Allowance for drift can be made by rotating the sight in accordance with readings on a drift meter.

#### CHARACTERISTICS

Focal length.....	1.9 inches.
Aperture.....	1.72 inches.
Adjustment range of sighting angle.....	—15 to +85 degrees.
Adjustment range of dropping angle.....	—15 to +85 degrees.
Adjustment range of drift angle.	30 degrees right or left.
Reticle arrangements.....	2 course marks.
Reticle cross with angle graduation (each graduation 0.5 degree).	
Bombsight dimensions.....	6.68 x 9.03 x 6.1 inches.
Base dimensions.....	4.32 x 3.34 x 3.14 inches.
Bombsight weight.....	6.6 pounds.
Base weight.....	2.86 pounds.

## Section V.. AIRPLANE SPRAY TANKS

### 1. GENERAL

Both pressure spray tanks and gravity-operated non-pressure spray tanks are used for disseminating chemical warfare agents from the air. These tanks are suspended under the wings or fuselage of the aircraft, attached to the bomb shackles. Spray release is effected mechanically or electrically over the bomb circuit. In emergency, full or empty tanks can be jettisoned.

### 2. NONPRESSURE SPRAY TANKS

Six models of nonpressure spray tanks, VAP, ranging in capacity from 11 to 185 gallons, are used (figs. 82, 83, 84, and 85). Two other models, VAP-200 and VAP-250, have been reported. They also can be adapted for scattering white phosphorous (fig. 83). This modification bears the designation ZAP.

The different models are identical functionally and are similar in design, consisting of a streamlined container with a discharge opening at the rear and an air intake in the front. When the lid sealing the discharge opening is lifted, the air intake opens automatically, admitting air, which forces the contents out through the discharge opening.

The two smaller models of nonpressure tanks, having capacities of 11 and 22 gallons respectively, are fitted with an adjustable suspension bar, which makes it possible to install them in various slanting positions to help the flow within certain limits. The larger models lack this adjustment mechanism. All are identical in design, differing only in dimensions.

All nonpressure spray tanks have a relatively large opening and are characterized by a correspondingly high rate of flow.

When used as incendiary spray equipment, the tank is filled with 1.2- to 1.6-inch lumps of white phosphorus, which are kept moist by water or a calcium chloride solution. An auxiliary container is attached underneath the spray tank. It is filled

	ZAP-4	ZAP-6	ZAP-500
Total weight..... (pounds)...	154	88	563.21
Weight WP filler..... (pounds)...	66	31.9	264
Capacity auxiliary container: gallons.....	1.12	1.12	6.7
pounds.....	4.25	4.25	25.2
Weight filler in auxiliary container..... (pounds)...	15	15	88.7
Other characteristics.....	See VAP-4M	See VAP-6M	See VAP-500

Figure 83.—Characteristics of nonpressure incendiary spray tanks.

with the smoke mixture, SIV, chlorosulfonic acid and sulphur trioxide. The spray tank and the auxiliary container are opened simultaneously. The phosphorus spray dries on contact with the smoke mixture and ignites in the air.

See figure 82, Characteristics of Nonpressure Spray Tanks, and figure 83, Characteristics of Nonpressure Incendiary Spray Tanks.

### 3. PRESSURE SPRAY TANKS

Airplane pressure spray tanks include the two models used for dissemination of smoke acid, DAP-

100 and DAP-200, and the UKhAP-500 spray tank which can be used for dissemination of either war gases or smoke. All tanks are of a conventional design, consisting of a streamlined pressure container with a nozzle-tipped discharge pipe at the rear end of the tank. The filling is expelled by air pressure supplied by a compressed air cylinder in the plane.

Universal spray tank UKhAP-500 is a pressure spray tank of recent design that can be used for either war gas or smoke.

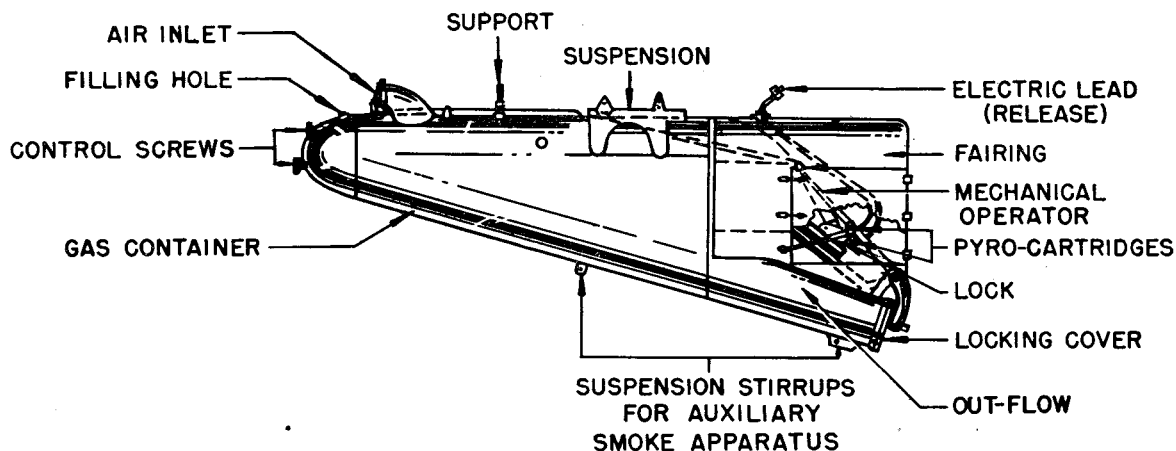


Figure 84.—Nonpressure spray tank VAP-500, VAP-1000.

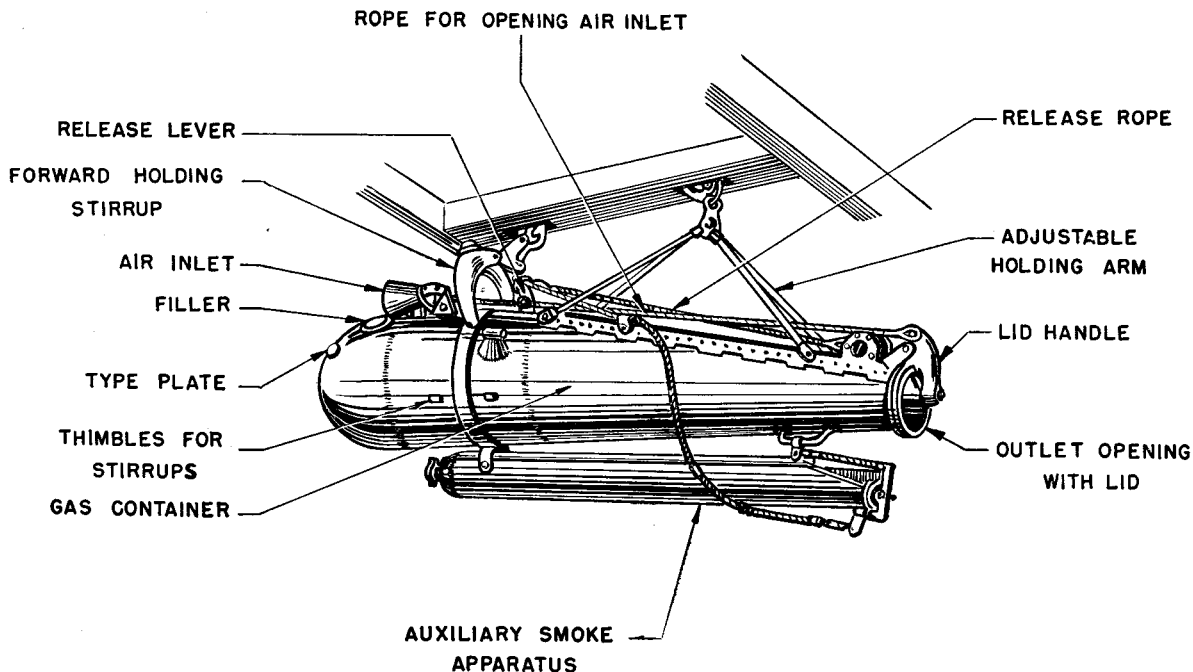


Figure 85.—Nonpressure spray tank VAP-6M with auxiliary smoke apparatus.

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## CHARACTERISTICS

Length..... 105.7 inches.  
 Operational capacity..... 81.6 gallons.  
 Weight empty..... 220 pounds.  
 Weight (filled with H)..... 1,100 pounds.  
 Weight (filled with smoke acid)..... 1,443.2 pounds.

Smoke spray tank DAP-100 has a total capacity of 26.4 gallons and an operational capacity of 22.4 gallons. With a 0.62-inch nozzle, the tank can be emptied in from 20 to 25 seconds. It is reported that this tank can lay a vertical smoke screen approximately 1,641 to 2,188 yards long, 55 to 82

Designation	Types of signals	Frequency (megacycles)	Transmitter power (watts)	Receiver sensitivity (microvolts)	Weight (pounds)	Power supply	Remarks
RSI-3 (transmitter)	Voice.....	3.5 to 5.....	3.....	.....	4.4	Run 30 A.....	2 tubes; oscillator and modulator.
RSI-3 (receiver)	.....do.....	5 fixed frequencies 3.5, 3.8, 4.125, 4.25, 4.4.	.....	60/10v	4.4	2.5-volt filament battery; 120-volt plate battery.	5 tube superheterodyne.
RSI-4 (receiver)	Voice, M. C. W.....	3.7 to 6.05 (continuously tunable).	.....	60/10v	4.4	RU. 11 A.....	6 tube superheterodyne.
RSWS-1.....	.....	38 to 48.....	.....	.....	.....	.....	This V. H. F. appeared in 1941, but has not been reported operationally since.
RSI-6.....	.....	.....	.....	.....	.....	.....	.....
RSI-5.....	.....	.....	.....	.....	.....	.....	.....
RPD-35.....	.....	.....	.....	.....	.....	.....	.....
RSB-Bis (transmitter).	Voice, C. W.....	2.5 to 4.05; 4.05 to 6.3; 6.3 to 9.5; 9.5 to 12.0.	13 to 36 (A1); 9 to 24 (A3)	.....	29.7	RVK-300A.....	2-stage crystal-controlled transmitter; voice modulation without amplification.
US (receiver) (part of RSB-Bis).	.....do.....	0.175 to 0.350; 0.350 to 0.900; 0.900 to 2; 2.15 to 5; 5 to 12.	.....	10/10v	12.1	RV-11A.....	8 valve superheterodyne; can be fitted with remote control by bowden cable.
US-3.....	.....	0.625 to 3.75.....	.....	.....	.....	.....	.....
US-4.....	.....	0.625 to 3.75.....	.....	.....	.....	.....	.....
RSR-1.....	.....	2.5 to 6.....	.....	.....	.....	.....	.....
DVINA-Bis.....	.....	.....	.....	.....	.....	.....	.....
RSR.....	.....	.....	.....	.....	.....	.....	Old equipment similar to RSB-Bis for reconnaissance aircraft.
RES.....	.....	.....	.....	.....	.....	.....	.....
SRM.....	.....	.....	.....	.....	.....	.....	.....
RPK 2 radio compass.	C. W., M. C. W., voice, visual indicators for D/F.	0.168 to 0.420; 0.420 to 1.	.....	1/10v	22.8	RUN-10.....	This installation is a full radio compass with rotatable loop and remote controls.
RPK 10.....	.....	0.270 to 0.850.....	.....	.....	.....	.....	This is a fixed loop homing set; reliability and accuracy is doubtful. 6 tube superheterodyne.
RPK-12 homing set.	.....	.....	.....	.....	.....	.....	.....
RPK MN 26J homing set.	.....	.....	.....	.....	.....	.....	Reported to be an American equipment to replace the RPK 10; it is found on the latest Aircobras.
Notch I, blind landing.	.....	29.6 to 43.9.....	.....	.....	.....	.....	.....
Blind landing set to replace Notch I.	.....	59 to 96.....	.....	.....	.....	.....	.....
13 PS.....	.....	0.275 to 0.550.....	.....	.....	.....	.....	Receiver only.
13 SK (transmitter)	Voice, C. W.....	2.5 to 4.48 in 2 bands.	40	.....	.....	.....	.....
13 SK (receiver)	.....	2.5 to 5.....	.....	.....	.....	.....	.....
14 SK (transmitter)	Voice, C. W.....	3.37 to 4.61.....	20	.....	.....	.....	.....
14 SK (receiver)	.....do.....	3.37 to 5.....	.....	.....	.....	.....	.....
15 SK (transmitter)	C. W.....	4 to 5.....	20	.....	.....	.....	.....

Figure 86.—Characteristics of Soviet airborne radio equipment.

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yards in depth, which provides effective obscuration from 8 to 20 minutes under average conditions.

## Section VI. RADIO AND ELECTRONIC EQUIPMENT

### 1. AIRBORNE RADIO

Soviet air-borne radio units (figs. 86 through 98) operate in the high frequency band. The fighter sets are small, lightweight, and of simple circuit design. This is characteristic of all Soviet airborne units, which are several years behind the communication sets built in the United States. For example, the RSI-3, which was used widely in 1945, employs a battery-pack power supply. By the end of the year, it was being replaced by RSI-4, which draws its cathode current from the plane's battery and its plate supply from a generator. Both sets have low receiver sensitivity (60 microvolt/10v.), and a transmitter output of only 3 watts, which indicates that they are used for short range work only.

A very high frequency set, the RSVS (33 to 42 megacycles) was used at later dates. It can be assumed that a set operating on such a narrow band would be impractical because of congestion of traffic.

**R/T INSTALLATION, RSI-3.** The RSI-3 is a R/T set with five fixed frequencies in the receiver. It is used in single-seat aircraft. The equipment is used for air-to-ground communication. Both transmitter and receiver have shock mounts.

**TRANSMITTER RSI-3.** See figure 88.

Circuit.....	Single-stage, self-excited.
Frequencies.....	3.5 to 5 mc/s.
Facility.....	Radiophone.
Power output.....	3 watts.
Tubes.....	2 Pentodes type 6P3. Oscillator and modulation amplifier.
Power supply.....	Dynamotor RUN30A.
Size.....	6.3 x 5.1 x 8.2 inches.
Weight.....	4.4 pounds.

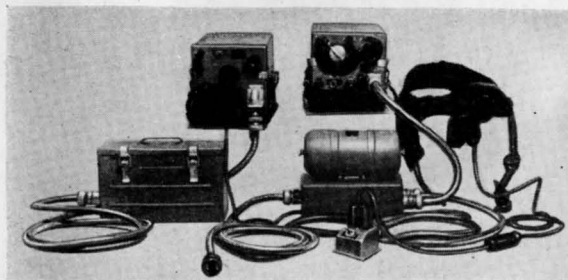
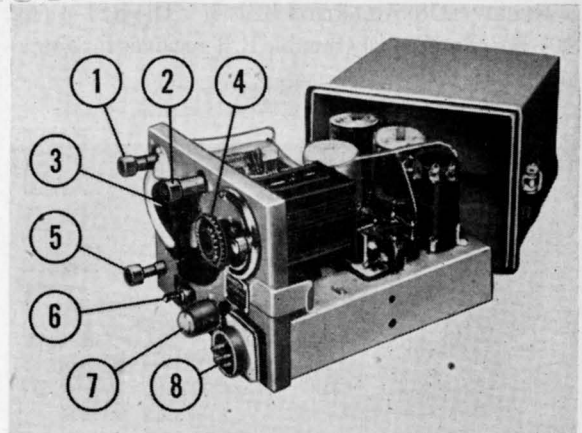


Figure 87.—R/T installation for RSI-3.

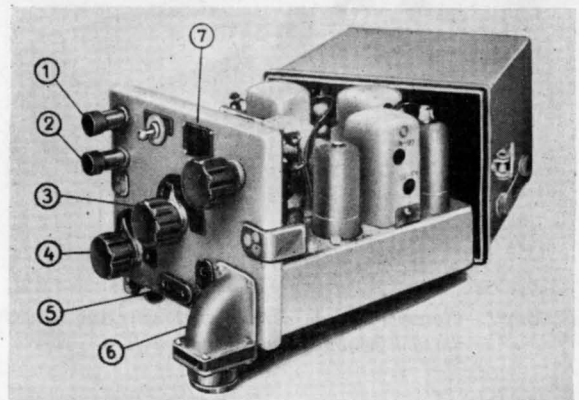


- |                              |                                |
|------------------------------|--------------------------------|
| ① Antenna post from receiver | ⑤ Ground                       |
| ② Antenna post               | ⑥ Switch for illumination      |
| ③ Primary tuner              | ⑦ Indicator in antenna circuit |
| ④ Antenna tuning             | ⑧ Power plug                   |

Figure 88.—Transmitter for RSI-3

**RECEIVER RSI-3.** See figure 89.

Circuit.....	5-tube, 7-stage superheterodyne.
Frequencies.....	Fixed frequency (3.5, 3.8, 4.105, 4.25, 4.4 mc/s).
Facilities.....	Radiophone, MCW.
Sensitivity.....	60 microvolt/10v.
Tubes.....	1 Heptode SB242, 3HF Pentodes SO241.
Power supply.....	2.1v lead and cell.
Size.....	6.3 x 5.1 x 7 inches.
Weight.....	4.4 pounds.



- |                             |                   |
|-----------------------------|-------------------|
| ① Antenna post              | ④ Fine tuner      |
| ② Ground                    | ⑤ Phone jack      |
| ③ Frequency selector switch | ⑥ Power plug      |
|                             | ⑦ Volume control. |

Figure 89.—Receiver for RSI-3.

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RECEIVER INSTALLATION RSI-4. The RSI-4 (fig. 90) is a continuously tunable R/T receiver for single-seat aircraft.

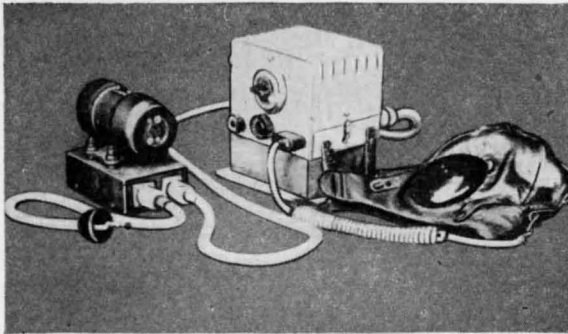


Figure 90.—Receiver installation for RSI-4.

RECEIVER RSI-4. See figure 91.

Circuit-----	6-tube, 9-stage superheterodyne.
Frequencies-----	3.7 to 6.05 mc/s.
Facilities-----	Radiophone, MCW.
Sensitivity-----	60 microvolt/10v.
Tubes-----	3 Pentodes 6K7, 1 Hep- todes 6A8, 1 double diode triode 6G7, 1 out- put Pentode 6F6.
Power supply-----	Dynamotor RU-11A.
Size-----	5.9 x 5.9 x 4.7 inches.
Weight-----	4.4 pounds.

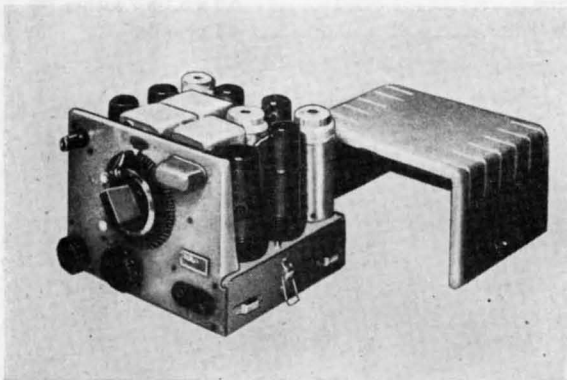


Figure 91.—Receiver RSI-4. Note that receiver also is used in tank mounted radio station 9-R.

AIRCRAFT UNIT RSB-BIS. For multi-seat aircraft air-to-air and air-to-ground communications. Box in upper left corner in figure 92 is dummy antenna for tuning transmitter.

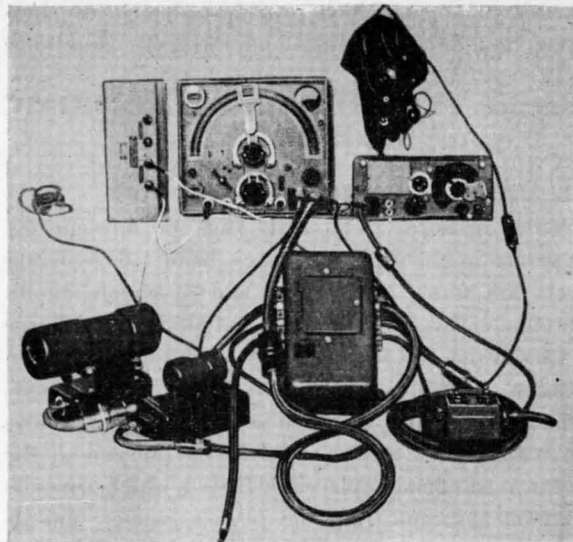


Figure 92.—Radio station RSB-bis.

TRANSMITTER RSB-BIS. A two-stage, crystal-controlled transmitter (fig. 93). Modulation during R/T is without amplification via microphone transformer on control grid of the output tube.

Frequencies-----	2.5 to 4.05 mc/s, 4.05 to 6.3 mc/s, 6.3 to 9.5 mc/s, and 9.5 to 12.0 mc/s.
Facilities-----	CW, radiophone.
Power-----	13 to 36 watts CW, 9 to 24 watts phone.
Tubes-----	Triode GU-4. Output Tetrode GKE-100.
Power supply-----	Dynamotor RVK-300A.
Size-----	13.8 x 12.6 x 7.9 inches.
Weight-----	29.7 pounds.

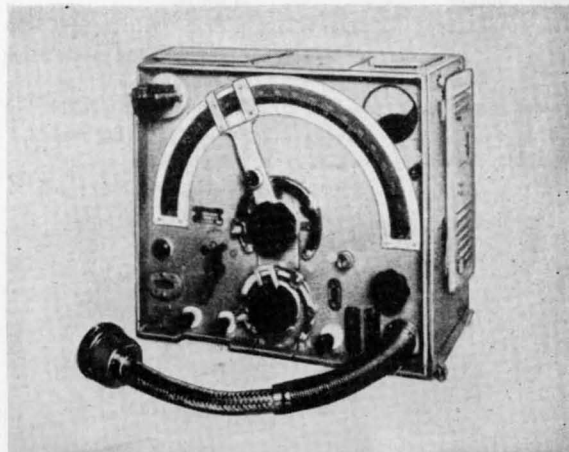
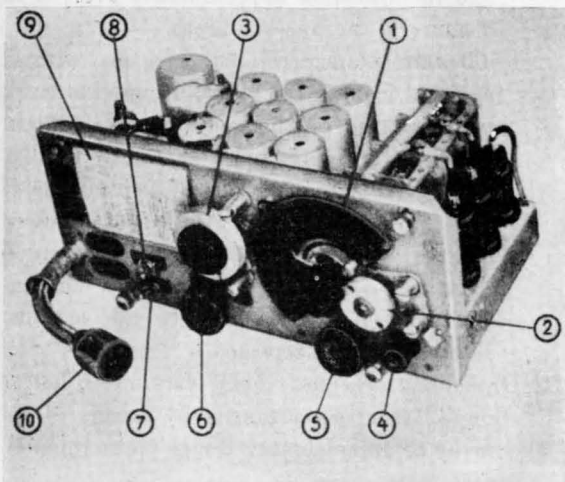


Figure 93.—Transmitter for RSB-bis.

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## RECEIVER US. See figure 94.

Frequencies	175 to 350 kc/s; 350 to 900 kc/s; 900 to 2,000 kc/s; 2.15 to 5 mc/s; 5 to 12 mc/s.
I. F. frequency	115 kc/s.
Sensitivity	10 microvolt/10V.
Tubes	4 Pentodes 6K7, 1 Pentode 6J7, 1 Heptode 6L7, 1 double-diode 6K6, 1 Triode 6F5.
Power supply	Dynamotor RU-11A.
Size	12.6 x 5.3 x 6.7 inches.
Weight	12.5 pounds.



- |                           |                    |
|---------------------------|--------------------|
| ① Primary tuner           | ⑥ Frequency switch |
| ② Remote tuner connection | ⑦ CW R/T switch    |
| ③ Fine tuner              | ⑧ A. V. C. switch  |
| ④ Antenna plug            | ⑨ Frequency chart  |
| ⑤ Volume                  | ⑩ Power cable      |

Figure 94.—Receiver US.

D/F RECEIVER UNIT RPK-2. Used for homing with visual indicator, and for direction-finding. It also can be used as a normal receiver for CW, MCW, and radiophone. See figure 95.

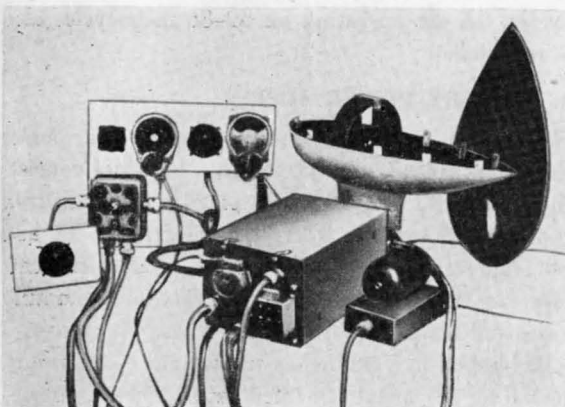


Figure 95.—D/F receiver unit for RPK-2.

RECEIVER RPK-2. This receiver (fig. 96) is equipped with A. V. C. and uses U. S. type metal tubes.

Frequencies	168 to 420 kc/s; 420 to 1,000 kc/s.
I. F. stages	112 kc/s.
Sensitivity	1 microvolt/10V.
Tubes	1 Heptode 6A8, 1 Heptode 6L7, 1 Pentode 6K7, 1 Pentode 6F6, 3 Triodes 6C5, 3 double diodes 6H6.
Power supply	Dynamotor RUN-10.
Size	16.9 x 9.45 x 8.25 inches.
Weight	22.8 pounds.

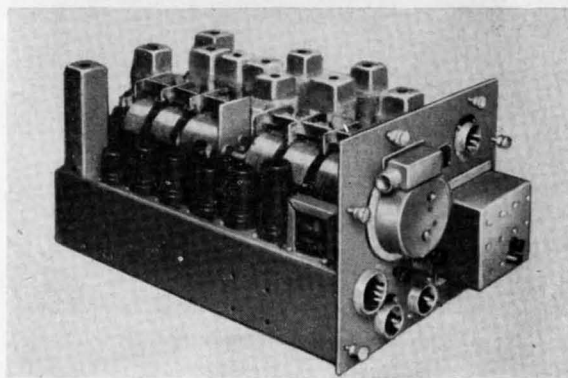
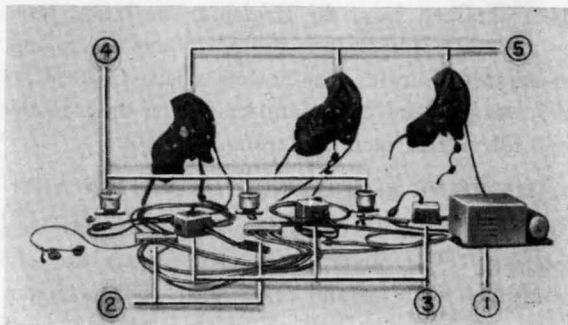


Figure 96.—Receiver for RPK-2.

## INTERCOMMUNICATIONS UNIT SPU-3.

Amplifier	Single-stage, low-frequency.
Tube	Pentode 6F6.
Power supply	Dynamotor RUN 10-A.
Size	Amplifier and dynamotor unit 7.1 x 13.8 x 6.3 inches.
Weight	20 pounds (less cables).



- |                            |                                    |
|----------------------------|------------------------------------|
| ① Dynamotor and amplifier  | ④ Buzzers and push buttons         |
| ② Junction boxes           | ⑤ Helmets (phone and throat mikes) |
| ③ Individual control boxes |                                    |

Figure 97.—Intercommunications unit for SPU-3.



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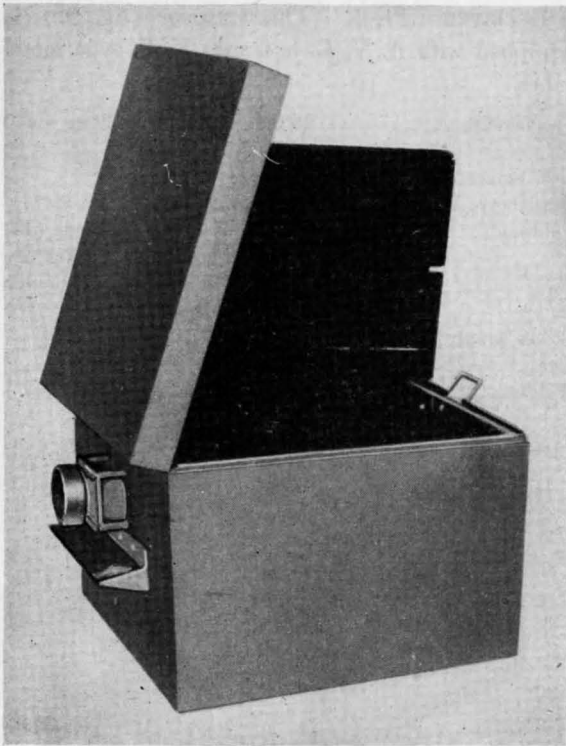


Figure 98.—Aircraft battery 12A-10.

#### AIRCRAFT BATTERY 12A-10. See figure 93.

Cells.....	12 in felt-lined metal case.
Strength.....	24V, 10 AMP.
Size.....	9.85 x 8.66 x 7.48 inches.
Weight.....	35.2 pounds.

#### 2. AIRBORNE RADAR

The Soviet Union made little use of airborne radar of any type. A few ASV-MK II sets are used on sea-reconnaissance aircraft, and a small number of sets were obtained from the British. The latter, however, could not be used to full advantage due to lack of suitable aircraft. The Soviets received 620 SCR-695 sets on Lend-Lease, and employed them in the lead aircraft to facilitate ground control.

#### 3. AIRBORNE ELECTRONIC NAVIGATION AIDS

No use of radar for navigational purposes has been reported. The Soviet D/F receivers are used in connection with ground radio nets. The principal receiver used is the RPK-2 which appears to be a copy of the Bendix radio compass, operating on frequencies of from 168 to 1,000 kilocycles. A fixed-loop homing set, the RPK-10, is used in a few day fighters and night fighters and in the lead aircraft of ground attack fighters. A RPK-12 was developed

to replace the RPK-2, but the performance was so poor that it became unpopular with the air crews. Production was discontinued.

Ground aids used with the above sets include the following:

CW transmitters which are within the frequency range of the air-borne receivers.

Radio transmitters in the 160 to 1,000-kilocycle band. These stations operate on a fixed frequency in rear areas, and change frequencies and identification approximately every 2 to 3 hours in the forward areas.

1,500-watt omni-directional beacons with a range of from 600 to 900 miles, used to mark turning point on the more important flight routes. These are supplemented by smaller (500 watt) beacons located near the airfields and between the more powerful transmitters and the flight routes. Identification, repeated from 2 to 3 times, is followed by a continuous note for approximately 20 seconds. Then the cycle is repeated.

Directional beacons. They transmit 16 letters on 32 compass segments by means of an array of 16 antennas. Range approximately 700 miles.

Ground radio D/F stations in the 3800-4150 kilocycle band, used to provide linear bearings on the home field. Located at airports, these transmitters operate only upon interrogation by aircraft.

Blind landing equipment is used. A few British SBA sets were purchased, but in insufficient quantity to have any influence on blind landing procedure in the Soviet Air Forces. The Soviet *Notch I* operates on the Loring principle in the 29.6-43.9 megacycles. A set operating on 59-86 megacycles also is reported.

#### 4. PRIMARY POWER SUPPLY

Radio and radar dynamotors operate on power drawn from lead-acid type storage batteries consisting of 6 or 12 cells (12 volts or 24 volts). Known types are 55 amperes, 12 volt, and 5, 10, 15, 30, and 60 amperes, 24 volt. The 24-volt, 10-ampere battery (fig. 98) can be used as a basis for estimating sizes and weights of the other types. It measures 9.85 by 8.66 by 7.48 inches and weighs 35.2 pounds, including the metal felt-lined case. These batteries are charged by the plane's generator (fig. 99).

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Type	Output (watts)	5-minute overload	Output (amps)	Volts	R. P. M.	Weight (pounds)	Length (inches)	Height (inches)	Diameter (inches)	Remarks
65-10-350.	350	525	12.7	27.5	3,200-5,900	16.1	8.45	5.75	4.34	Can be turned either direction.
65-20-650	650	975	23.6	27.5	3,200-5,900	25.3	9.82	6.55	5.12	Do.
65-1000...	1,000	1,500	37	27	3,200-5,900	31.7	11.97	6.70	5.04	Can be turned either direction. Control for common positive pole of armature and field.
DSF-500..	350	.....	29	13.5	1,600-3,200	26.4	12.40	.....	5.04	

Figure 99.—Aircraft generators.

**5. GROUND RADAR**

The U. S. S. R. started production of an early warning type of radar in June 1941 and produced a few sets operating on approximately 400 megacycles. This set was entirely original in design and shows no influence from other nations. An RGO, used as a transmitter, produces an electro-magnetic field 60 miles long and 75 miles wide in opposing directions. Two receiver units, RPO, are set up at the ends of the range. As soon as a target crosses the 120 mile beam it becomes visible on a cathode ray tube.

A few gun-laying radar sets were manufactured by the Soviets and were used by the Red Navy. However, a large number of British gun-laying radar units were observed in the Moscow area, so it may be assumed that production on this type of equipment was stopped when British and United States units became available through lend-lease.

A Soviet set, RUS-2, is of British origin and is used for measuring altitude and range. This set is mounted on a truck, with a two-arm antenna mount extending through the roof. Three small antennas are at each end. Another set, the RUS-5, has slightly greater range, approximately 100 miles as contrasted with 75 miles of the RUS-2.

**6. FUTURE TRENDS**

The contacts which the Soviets have had with United States, British, and German equipment probably will result in positive advancement of Soviet equipment.

From the United States, the U. S. S. R. received the following air-borne units on lend-lease:

SCR-695 (I. F. F.)  
SCR-718 (radar altimeter)  
MN-267  
AN/ARN-7 (radio compass)

*Testing equipment*

TS-10/APN  
TS-16/APN  
IE-46  
IE-12  
RC-54  
RC-55

*Communications equipment*

BC-453  
BC-454  
BC-455  
BC-456  
BC-457  
BC-458  
BC-696  
SCR-277

The Soviets are thought to have captured the files of the German Works Commissions of the Radar Committee, which examined all captured Allied radar equipment. The German research probably will be exploited.

Impeding progress in electronic development is the lack of sufficiently trained personnel to manufacture the equipment, and the greatly retarded development of the vacuum tube industry. Soviet tubes, at present, are limited in variety and are of poor quality. Characteristics vary so much in the same series of tubes that it is impossible to guarantee that any one tube will replace one of the same model. Unless the Soviet vacuum tube industry can widen its range and improve its product, radio and radar development will of necessity be slow and difficult.

**Section VII. COLD WEATHER OPERATION****1. GENERAL**

The Soviet air forces are able to conduct operations in the coldest weather. All aircraft, except for a few types which do not require them, may be fitted with skis. In most instances, the skis are retractable. Flying boats and float-planes are fitted with special skids for operations from ice.

**2. CARE OF ENGINES**

Oil is drained from United States engines, procured by the Soviet air forces through lend-lease, at the completion of operations. Hot oil is poured into the engines for starting. Oil is heated to 170° F.

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Figure 100.—Starting an engine in extreme cold.

in a specially designed truck, equipped with an oil or wood-burning boiler. It then is pumped into the planes. This operation requires a minimum of time and does not delay take-off preparations.

Oil is not drained from Soviet aircraft. It has been reported that clearances in Soviet engines are much smaller than those of United States design and that Soviet aircraft, therefore, use a much thinner type of oil.

Heaters are installed and operate approximately 10 minutes, during which time American engines are filled with hot oil (fig. 100). Engine covers and heating equipment are removed, the propellers are turned at least four revolutions, and eight shots of primer are applied. Engines start, usually on the first attempt, in from 13 to 18 minutes from the beginning of starting operations. Engines are idled for approximately 10 minutes for thorough warm up. No difficulty seems to be encountered in fighter engines overheating when idling.

Soviet engines use

is attached for use as a reserve bank.

Engine covers are of quilted cotton approximately three-fourths inch thick. They fit closely and permit the propeller to turn. In liquid-cooled engines, the heating duct is introduced at the rear lower section of the engine.

During the warm-up, all traps are opened and drained to insure that there is no water in the traps and that none remains frozen. All traps are drained at the completion of operation.

In extremely cold weather, air-cooled engines are fitted with an aluminum baffle inside of the engine cowl. This baffle has sliding shutters, which are controlled mechanically from the cockpit. It is believed these are necessary both for warming up and to prevent freezing while gliding.

All tubing is wrapped first with paper, then with wool cloth, and finally with asbestos-covered, fire-proof material. This is considered necessary at temperatures of  $-86^{\circ}$  F. or less.

A 70-30-percent mixture of alcohol and glycerine by volume is used in hydraulic systems. This mixture will not freeze above  $-140^{\circ}$  F.

Either "Prestone" or a Soviet antifreeze compound of ethyl-glyco is used in liquid-cooled engines.

On completion of each operation, a check is made to insure that brakes have been released completely to prevent their freezing in a locked position.

### 3. SPECIAL EQUIPMENT

**a. PSE-1 Ignition Apparatus.** THE PSE-1 special ignition apparatus produces a more intensive sparking than the starting magnetos. This device operates on the principle of battery ignition, although it is a part of airdrome equipment, it may be carried in aircraft. It is designed to give from 200 to 250 starts. The alkaline accumulators employed do not require special care, and are not sensitive to low temperatures.

The PSE-1 consists of a starting coil with vibrator, and alkaline 12-volt accumulator battery, and a starting push button. It is housed in a wooden case, divided into three parts by removable partitions. The largest compartment holds the battery, which is protected from cold by a felt layer 0.23 inch thick. The coil is fixed to the movable partition wall inside of the second compartment. The third compartment holds a reserve of electrical leads. On the

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